

## ARCHIVES OF OTOLOGY.

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### SOME POINTS IN THE DIAGNOSIS OF THE COMPLICATIONS OF TEMPORAL-BONE DISEASE BASED UPON A STUDY OF 135 FATAL CASES.<sup>1</sup>

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**I**SOLATED cases of intracranial suppuration which have been brought to a successful issue are frequently published, but a careful study of the symptoms in these cases is rarely instructive ; either the symptoms were of the most obvious character or else the cases recovered by a fortunate association of fortuitous circumstances.

During the last fifteen years, 892 cases of temporal-bone disease were operated upon at the General Infirmary at Leeds by our predecessors, my colleagues, and myself. Of these cases 146 died.

A study of these fatal cases, where careful post-mortems revealed lesions in some cases unsuspected during life or with symptoms rendering a correct diagnosis a matter of the greatest difficulty, presents many interesting features. I regret, however, that I have no very striking or epoch-making conclusions to lay before you.

Of the 146 cases, 11 died from other causes, such as diabetes, cardiac disease, etc. In the remaining 135 cases, death was more or less directly referable to the temporal-bone disease.

Eleven cases died from exhaustion ; ten of these were

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wasted infants under one year old ; all had very extensive mastoid disease and subnormal temperature after operation, and died of inanition in from ten to thirty days afterwards. In 2 of these cases necrosis of the labyrinth was found. The eleventh case was 2½ years old and had chronic diarrhœa with acute mastoid abscess associated with vomiting, rigors, retraction of neck, drowsiness, and constipation. She was almost moribund on admission to the hospital, revived under stimulants, but died of shock at the completion of an extensive operation.

Nothing abnormal in the brain or elsewhere was found at the post-mortem ; a culture of the pus gave no growth. In this case the symptoms pointed to intracranial suppuration and it was necessary to explore the brain ; the prolonged operation undoubtedly proved fatal, but a less complete operation would not have been justifiable.

In young children with defective stamina, it is certainly wiser not to aim at complete removal of all disease at one operation ; the establishment of good drainage and the removal of the more serious disease should be accomplished at the first stage, and at a later period a more complete and satisfactory radical operation performed.

In 2 cases no obvious cause for death was discovered at the post-mortem. One case where persistent vomiting, optic neuritis, coma, nystagmus, and conjugate deviation of the eyes were present I have already reported to the Society.

In the second case two serious and alarming hemorrhages, with persistent uncontrollable oozing from the whole of the wound in the bone and not at all from the soft parts, were followed by jaundice, temperature of 102°, and collapse ; the organisms obtained from the pus were streptococci, and anti-streptococcic serum was injected without success. At the post-mortem no gross lesion of any organ was found. Probably in both cases an acute septic infection caused death.

In 22 cases, acute miliary tuberculosis caused a fatal issue ; in 18 the meninges were affected and the symptoms those of tubercular meningitis.

In 8 of the 22 cases some other primary forms were present, but in the remaining 14 the temporal-bone disease

seemed to be the sole focus of infection. Nineteen cases were under two years of age ; in every case either symptoms of tuberculous meningitis or distinct evidences of general tuberculosis were present before operation, and in no case could the operation be regarded as the originating cause of a general disseminated miliary tuberculosis.

In 5 cases when admitted, an ordinary catarrhal pneumonia complicated an acute mastoid disease following upon chronic otorrhœa, the pneumonia proving fatal.

In 3 cases an extradural abscess situated over the sigmoid sinus was evacuated during the mastoid operation, death subsequently ensuing from septic broncho-pneumonia.

In these cases rigors and remittent temperature had preceded operation but the sinus was found to contain fluid blood. No septic thrombus or alteration in the vessel wall was found post-mortem, although the infection must clearly have been conveyed through the sinus. No uncomplicated case of extradural abscess died.

Of the remaining 93 cases, serous meningitis was present in 1, general meningitis in 33, meningitis and sigmoid sinus thrombosis in 10, meningitis and cerebellar abscess in 5, meningitis and temporo-sphenoidal abscess in 6, sigmoid sinus thrombosis alone in 1, with pneumonia in 9, with cerebellar abscess in 7, temporo-sphenoidal abscess and thrombosis of the petrosal sinus in 1, temporo-sphenoidal abscess alone in 8, temporo-sphenoidal abscess and cerebellar abscess in 2, and cerebellar abscess alone in 10.

The accompanying table shows the relative frequency with which the usual symptoms mentioned in the text-books have occurred in each group, and the leading points may be briefly summarized.

In the 17 cases of temporo-sphenoidal abscess, intense headache was present in all, vomiting in 13, drowsiness deepening to coma in 10, optic neuritis in 5.

In the 9 uncomplicated cases, temperature and pulse were subnormal in 2, in the cases with meningitis the rate was much above normal, and in the 2 cases with cerebellar abscess subnormal.

	Cerebral Abscess, 9 cases.	Cerebral Abscess with Meningitis, 6 cases.	Cerebral Abscess with Cerebellar Abscess, 2 cases.	Cerebellar Abscess, 10 cases.	Cerebellar Abscess with Meningitis, 5 cases.	Cerebellar Abscess with Sinus Thrombosis, 6 cases.	Sinus Thrombosis, 1 case.	Sinus Thrombosis with Pneumonia, 9 cases.	Sinus Thrombosis with Meningitis, 10 cases.	Meningitis, 33 cases.
Headache.....	9	6	2	9	5	5		3	4	21
Vertigo.....	1	1		2		3				2
Vomiting.....	7	4	2	5	5	3		3	6	12
Slow cerebration.....	5		1	2	1					
Drowsiness or coma.....	6	3	1	6	1	4				9
Constipation.....	2	4		2	1	1				
Subnormal temperature...	2	1	2	2		1				
High temperature.....		5			4	3		9	10	29
Remittent temperature....					1		1	9	10	29
Slow pulse.....	2	1	2	2		1				
Rapid pulse.....		5					1	9	8	15
Slow respirations.....	2	1	2			1				
Rapid respirations.....								9		
Optic neuritis.....	5			2		1		2	3	8
Pupil dilated on side of lesion.....	1									
Pupils unequal.....						1				3
Paralysis of limbs on side of lesion.....										
Paralysis of limbs on opposite side.....	1	1								2
Deviation of eyes to lesion.....		1								2
Deviation of eyes from lesion.....										
Strabismus.....		1							1	3
Nystagmus.....				2		1			1	1
Knee jerks absent.....	3	1				2				3
Knee jerks increased.....										2
Retraction of neck.....				1		1			1	4
Muscular twitchings or contractions.....					5				7	12
General convulsions.....		1		1	4				10	
Delirium and mental excitement.....		5			5	1	1		7	7
Rigors.....						2	1	8	5	1
Tenderness over jugular ..							1		1	
Age under 10.....			1	1	1	1		3	4	16
between 10 and 20 ...	4	4	1	3	3	3	1	6	1	5
between 20 and 40 ...	4	2		5	1	2			5	7
over 40.....	1			1						5



In the 6 cases with meningitis, delirium, restlessness, etc., were present.

In only 1 case, and that one of the uncomplicated ones, was the pupil on the affected side dilated and fixed.

In 4 of the 22 cases, the patellar reflexes could not be elicited. Sudden death occurred in 2 of the uncomplicated cases. In *no* case was an acute mastoid abscess present.

One of the cases with meningitis had rigors and developed a septic broncho-pneumonia.

Among the 21 cases of cerebellar abscess, headache was present in 19, vertigo in 5, vomiting in 13, drowsiness in 11, optic neuritis in 3, subnormal temperature and slow pulse in 3 only, constipation in 4.

Rigors occurred twice in the cases with meningitis and twice in those with lateral sinus thrombosis.

In the group with meningitis, delirium, restlessness, with muscular twitchings, were a conspicuous feature.

Sudden death occurred in 4 of the 10 uncomplicated cases, and in 1 other respiration ceased during the operation and although the heart was kept going for several hours spontaneous breathing was never re-established.

In 10 of the 21 cases, an external mastoid abscess was present.

Pupils were unequal in 1, nystagmus present in 3. The patellar reflexes never exaggerated, in 2 cases not obtainable.

Of the 20 cases of sigmoid sinus thrombosis rigors were present in 14, high and often remittent temperature in all, headache in 7.

Optic neuritis in 5, vomiting in 9.

Of the 33 cases of meningitis, headache was present in 21, vomiting in 12, mental excitement and delirium in 16, drowsiness in 9. Muscular twitchings in 12, convulsions in 10, pupils dilated in 2, unequal in 3, optic neuritis in 8, elevated and fluctuating temperature in 21. Increased patellar reflex in 2, absent in 3; conjugate deviation of the eyes from the affected side in 3, towards the affected side in 2. External mastoid abscess was present in 17.

The absence of the classical symptoms is a striking feature of these cases; this was not due to an omission

to note symptoms; in nearly all the cases definite mention has been made when symptoms of intracranial complications might have been expected, but were absent.

Headache was almost uniformly present in those cases where a brain abscess was present.

Vomiting was very frequently noted, but was absent in half the cases of uncomplicated cerebellar abscess.

Drowsiness or coma was about equally frequent in cerebral and cerebellar abscess.

Optic neuritis was more frequently observed in cerebral than in cerebellar abscess, and was rather remarkably common in the cases of meningitis, being present in 8 out of 33.

Subnormal temperature and slow pulse were comparatively infrequent, being found in only 8 cases of abscess out of 38.

Infection of the sigmoid sinus and meningitis were almost invariably associated with high temperature, and in the former group the usual remittent temperature was found in all but 2 cases.

The condition of the pupils was rarely an aid to diagnosis; in only one case of temporo-sphenoidal abscess was the typical dilated pupil on the side of the lesion present. Conjugate deviation of the eyes was not present in any of the cases of cerebellar abscess, although found in 1 case of cerebral abscess, with meningitis, and in 5 cases of simple meningitis.

Nystagmus occurred in 3 cases of cerebellar abscess. The patellar reflexes were absent in 4 cases of cerebral abscess and in 2 of cerebellar.

Delirium, muscular twitchings, contractions, or convulsions were almost uniformly present in all the cases where meningitis caused death.

Rigors occurred in 16 out of the 26 cases of thrombosis of the sigmoid sinus, but were never observed in any uncomplicated case of cerebral or cerebellar abscess, and in only 1 case of meningitis.

There was an antecedent history of chronic otorrhœa in 21 out of the 33 cases of meningitis; in 17 out of the 20

cases of sinus thrombosis; in 20 out of 21 cases of cerebellar abscess; in 13 out of the 15 cases of cerebral abscess, and in 1 of the 2 cases of combined cerebral and cerebellar abscess.

The average age of the cases of sinus thrombosis was 15, 7 being under 10.

The average age of the cases of meningitis was almost 17; 16 cases, nearly half, being under 10.

The average age of the cases of cerebellar abscess was 20; 3 being under 10.

The average age of the cases of cerebral abscess was 23, only 1 being under 10, and that was a case of combined cerebral and cerebellar abscess.

It is a feature of some interest that external mastoid signs were never observed in association with temporo-sphenoidal abscess, but occurred in about half the cases where cerebellar abscess or meningitis caused death.

Examinations of the cerebro-spinal fluid obtained through a lumbar puncture, and of the blood, were made in a number of instances, but were never found to be of diagnostic significance in the early stages of those cases where the diagnosis was uncertain.

Positive indications were only obtained when the diagnosis was beyond doubt.

A CASE OF HYSTERICAL MASTOID TENDER-  
NESS AND PAIN, WITHOUT FUNCTIONAL  
DISTURBANCE.

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A young girl, D. E., fourteen years of age, was admitted to the Massachusetts Charitable Eye and Ear Infirmary, service of Dr. Edward M. Plummer, on September 23, 1905.

*Family History.*—Mother had always been "very nervous."

*Past History.*—One year ago said to have had a severe attack of pain and slight swelling over the right mastoid, which has persisted up to the present time. Pain worse "by spells." Tonsils reported having been removed in March, 1905. Patient felt slightly better until July, when the pain again returned with renewed severity.

*Present History.*—Says she has had headaches the past ten days, with intermittent tinnitus. Complains of pain in and radiating from the right mastoid, and thinks she has some trouble inside the ear. Nausea one day, no vomiting. Has "dizziness about the head," experienced on stooping. Taken into the hospital for observation.

*Physical Examination.*—Poorly developed and nourished. Stoops considerably. Pale, not anæmic. Watches one rather excitedly during the examination.

*Right Ear:* Membrana tympani very slightly retracted, rather thin; otherwise normal. Outline of malleus and incudo-stapedial joint easily seen. Canal walls normal. Mastoid process rather prominent. The entire, sharply defined area over the right mastoid is very tender and painful; does not follow distribution of any particular nerves. No œdema. Skin found

"peeling" and a little reddened from a weak solution of tr. iodine applied several days before.

*Left Ear:* Membrana tympani normal; mastoid process prominent like its fellow on opposite side. No mastoid tenderness.

Functional tests: whispered voice, Rinne, Weber, Galton whistle, and tuning-forks normal in both ears.

No neck tenderness. Teeth carefully examined, and found in excellent condition. Teeth had also been examined by a dentist a short time before. A thorough examination of all other organs was negative. No vaginal.

*September 27th.*—The skin over the right mastoid is normal in appearance, no œdema. Right mastoid process very tender, the slightest touch causing not only signs of distress, but a violent attempt to jerk the hands away. Still complains of radiating pain over the mastoid. Middle ear normal. Quantitative and qualitative tests normal. No dizziness. Cried in the dressing-room this morning from no apparent cause. Declares her ear is very painful.

*September 30th.*—Patient seen by Dr. G. A. Waterman, a nerve specialist, who finds: "Very slight nystagmus, area over the right mastoid hyperæsthetic—very slight spasm of the right sterno-cleido-mastoid muscle. No stigmata of hysteria present, although this does not eliminate the possibility of psychic pain. Suggestive treatment advised."

Temperature after the visit was 100° F. for the first time. Middle ear and tests normal.

*October 10th.*—The girl has been given electrical treatment every day at the Nerve Out-Patient Department of the Massachusetts General Hospital and suggestive treatment. Thinks the mastoid is less tender, but not quite sure of this. Still jumps if a motion is made to feel the part. Potassium iodide gr. xv. t.i.d. and strengthening diet prescribed. Treatment consisted essentially in psychotherapy.

*October 23d.*—Pain and mastoid tenderness have entirely disappeared for several days. Says she is well again, and looks much brighter. Middle ear and hearing test normal. Discharged from the hospital well.

The interesting features of this case are:

Hyperæsthesia of a considerable degree and unilateral mastoid pain. Contrary to most of the reported cases of

this character, the functional tests were all normal, the hearing not having been affected at any time to the slightest extent. The slight spasmodic contracture of the sterno-mastoid muscle (tonic) is in perfect accord with the condition.

The mastoid trouble seems to me analogous to the so-called "hysterical joint," namely, sensitiveness without swelling.

The diagnosis from the predominance of subjective over objective symptoms, the presence of a very slight contracture, and the history of nervousness, as well as antecedents, seem clear.

Prognosis must surely be somewhat uncertain. A relapse under the influence of another exciting cause would not be surprising.



PRIMARY CAVERNOUS SINUS THROMBOSIS  
SECONDARY TO OSTEOMYELITIS OF  
THE PETROUS PYRAMID.

By ARNOLD KNAPP, M.D.

(With one illustration on Text-Plate IV.)

F. B., Italian, aged thirty. Suffers from diabetes and ozena. On October 18, 1905, the left ear began to pain. He applied for treatment at the New York Ophthalmic and Aural Institute. Paracentesis was performed, discharge set in, and he was somewhat relieved. The incision of drum was repeated after a week; he then stayed away from the hospital. On November 15th the discharge ceased; he suffered from severe headache in the right half of the head, for which he received treatment by his physician at his home until the right eye began to protrude. On November 22d he was admitted to the hospital.

*On Admission.*—Pale, rather emaciated man, of medium size. Temperature, 99° F.; pulse, 80; respiration, 18. Complains of very severe pain in right half of head, especially in eye.

*The right eye* is very prominent, the protrusion being straight forward in line with the orbital axis; motility equally restricted. Pupil reacts. V =  $\frac{3}{8}$ ; F. n. Fundus neg. No tenderness over frontal sinus. Left eye is normal.

*Right Ear:* Canal dry. The drum is thickened and red; apparently no bulging. No details visible. No tenderness over mastoid process. H = (watch)  $\frac{3}{4}$ . Left ear normal.

The nose and throat present the pronounced features of an atrophic process with scabs.

Urine contains large quantity of glucose. The patient is perfectly conscious and rational.

*November 23d.*—Moaned and complained of right eye, ear,

and throat ; vomited during night. The eye is more protruding. Throat shows a membranous exudate on tonsils. Complaints of headache. In evening became very restless and excited. Leucocyte count, 25,000. A.M.: temperature, 99° F.; pulse, 84. P.M.: temperature, 101°; pulse, 79.

*November 24th.*—Very severe pain in attacks localized to right half of head. Seems dazed and stuporous. At 5 P.M. the left eye is protruding. The exophthalmos right is more marked, with chemosis of conjunctiva. Right optic disc shows venous congestion. Left normal. Pain over temporal region. There seems to be trouble with the throat ; he is continually expectorating and clearing throat. Paracentesis performed. Pus escaped. This contained diplococci in capsules. General condition is not so good ; he is delirious at times. Takes nourishment well. A.M.: temperature, 102°; pulse, 80. P.M.: temperature, 103°; pulse, 96.

*November 25th.*—Restless and stuporous. Right ear discharges profusely. Left eye more protruding. Both eyes painful. Headache. Delirious. Chokes on swallowing ; coughs, and fluids regurgitate. During night, attack of great weakness which requires stimulation. A.M.: temperature, 101°; pulse, 101. P.M.: temperature, 101.8°; pulse, 94.

*November 26th.*—Worse. Left eye more protruding. Right apparently less. Some twitching of head and limbs. Involuntary urination. Profuse otorrhœa. Difficulty in swallowing. Pulse perceptibly weaker. A.M.: temperature, 102°; pulse, 100. P.M.: temperature, 103°; pulse, 103.

*November 27th.*—Condition gradually failing. Coma. Temperature, 106°, and died 12 M.

*Autopsy.*—5 P.M., November 27th. Dura unusually adherent to skull. Surface of brain normal ; some œdema of pia. Blood-vessels in right Sylvian fissure thrombosed and purulent. On lifting up the brain, base normal ; anterior extremity of right cerebellar lobe showed some purulent exudate. Right lateral sinus contains post-mortem clot. In the right sigmoid sinus there is a disintegrated but recent clot, becoming purulent as it approaches the bulb. Superior petrosal sinus normal. Dura over right cavernous sinus bulging and yellow ; on opening this a cavity filled with thick, creamy pus is exposed. The left cavernous sinus also contained pus. Sphenoidal sinuses healthy. After removing dura from surface of petrous pyramid, a round, cari-



ILLUSTRATING DR. ARNOLD KNAPP'S CASE OF PRIMARY CAVERNOUS  
SINUS THROMBOSIS.



The dark areas show the site of the carious defects at the apex of the petrous pyramid.

ous defect, 1 cm in diameter, in the bone is found at apex just underneath the Gasserian ganglion (see illustration), anterior and internal to internal auditory meatus. The meatus and its contents appear healthy. Another defect is found along the superior petrous margin somewhat externally (see illustration), but communicating with the cavity at the apex of petrous pyramid. The temporal bone is divided by sections in the plane of the petrous pyramid. The tympanum is filled with swollen mucous membrane. There is no fistula on inner wall. The antrum is small and completely filled with swollen granulations. The mastoid process is entirely infiltrated, though no actual cavities or disintegration can be observed. The infiltration extends inward from the antrum just above the external semicircular canal throughout the cancellous tissue and communicates with the carious areas near the petrous apex described above.

*Remarks.*—The middle ear and antrum were originally infected from the nose. The rapid and extensive involvement of the temporal bone is explained by the diabetic condition of the patient, which, moreover, contra-indicated any operation. The anatomic peculiarity of an unusually thickened mastoid cortex aided in the extension inward of the morbid process, and accounts for the lack of external mastoid symptoms. The post-mortem examination of the temporal bone revealed an osteomyelitis of the petrous pyramid, without any distinct pus, but with the presence of granulations and disintegration of bone. This extended directly inward above the external semicircular canal to the defects in the bone along the superior petrous margin and at the Gasserian fossa (see illustration). The process presumably reached the Gasserian ganglion at a period coincident with the intense neuralgic pain from which the patient suffered. The distance then to the cavernous sinus is a short one.

In the ARCHIVES OF OTOTOLOGY, vol. xxxi., p. 321, an article appeared on the "Involvement of the Gasserian Ganglion in Middle-Ear Suppuration," by Dr. R. Hilgermann of Breslau. In it, it is stated that the well-known path of extension is found in the pneumatic cavities of the petrous bone; these cavities, though usually only found in

the mastoid process, may extend throughout the entire pyramid. The extension may occur through some cells situated anteriorly near the tympanic ostium of the Eustachian tube. The pneumatic cells directly inward of the hypotympanic space may be involved, or infection may travel by the carotid plexus of veins surrounding the carotid artery.

In our case the internal auditory meatus was macroscopically normal, there were no previous clinical signs of labyrinth involvement, and hearing was not extinguished. The purulent thrombosis of the cavernous sinus was secondary to the osteomyelitic focus at the petrous apex (*impressio trigemini*). The condition then extended to the cavernous sinus of the other side, causing exophthalmos, and backward to the jugular bulb and sigmoid sinus of the same side. These were unquestionably secondary, from their appearance at autopsy.

Cavernous sinus thrombosis is usually secondary to sigmoid sinus thrombosis, or affection of the ophthalmic veins. In ear disease it occurs in one of three ways. First: Sigmoid sinus thrombosis through intermediary of the petrosal sinuses. Second: Carotid plexus of veins surrounding the carotid artery by infection from the tympanic cavity. Third: Involvement of the petrous cancellous cells, either from the cells on the inner wall of the tympanum or from mastoid antrum, as in this case. The involvement of the cavernous sinus presented some interesting features. The extension to the cavernous sinus of the other side is usual, and the subsidence of the exophthalmos on the first affected side has been frequently noted, and is due, according to Macewen, to establishment of the collateral circulation.

Symptoms of pyæmia were absent, and meningitis, the usual outcome, did not come to recognizable development. The interference with the orbital circulation should show itself, as one would think, in the eye-ground. In our case, however, there was no change, which agrees with Jansen's experience (*Encyclopedie d. Ohrenhkl.*, p. 369).



## THE NATURE OF OTOSCLEROSIS IN THE LIGHT OF HEREDITY.

By O. KOERNER, ROSTOCK.

Translated from *Zeitschr. f. Ohrenheilk.*, Vol. L., 1905, German Edition of  
these ARCHIVES.

IT is an old matter of experience that progressive deafness occurs in several successive generations of a family. The first person to draw attention to this heredity was von Troeltsch. He believed that in deaf families peculiarities in the structure of the skull were inherited which favored the onset of the so-called chronic simple ear catarrh. These peculiarities consisted in: (1) a congenital narrowing of the naso-pharynx and tubes which induced chronic catarrhs of the pharynx and tubes resulting in tubal occlusion; (2) a peculiar structure of the labyrinth windows and their surroundings and a shallowness of the tympanum which represented favorable conditions for the development of adhesions.

This assumption is correct to a certain degree as regards tubal catarrhs and adhesive processes in the tympanum. It does not, however, explain the heredity of that process which to-day we designate as otosclerosis and separate from the collective term "chronic simple aural catarrh" of von Troeltsch. This process, which occurs principally in the bone surrounding the labyrinth, invading the tympanum only near the labyrinth wall and its windows, cannot be the result of unfavorable conditions in the pharynx, in the tubes or in the tympanum, and it is, according to our present knowledge, the only condition which leads to inherited progressive deafness. Some authors, including Politzer, are even inclined to

regard the hereditary tendency to otosclerosis as of importance in differential diagnosis against the adhesive process.

This would suffice to explain the necessity of examining the hereditary characteristics of otosclerosis more thoroughly than has been done thus far. The hereditary feature has been regarded indifferently, rather as a curiosity. Little did we expect that biology would develop a theory of heredity which is capable of explaining the much-discussed nature of otosclerosis.

We must first state what is known of the method of inheritance of otosclerosis and then add what is new.

Though the heredity of otosclerosis has been generally accepted, we do not know how frequently it occurs. The statements of patients about the ear diseases of their immediate ancestors are incomplete and the physician is rarely in a position to examine all the members of the family of the patient and to obtain reliable information about the diseases of those who have died. It is therefore certain that the statements on the frequency of heredity mentioned in literature give too small figures. Thus among forty-two cases collected by Panse only three gave definite information about similar affections of other members of the family. Siebenmann, Denker, and Bezold found that among their patients 35%, 40.5%, and 52% gave a hereditary history. Even these figures, which do not, of course, include an aural examination of all the living members of the families of the patients, are much too small. We shall see later on that every case of otosclerosis is inherited.

Of considerable importance for the determining of this question is the formation of family trees of those suffering from otosclerosis. In literature I have only been able to find two family trees in an interesting communication of Hammerschlag's. I add three similar trees from my own observations, which together, I think, furnish some interesting deductions.

My family trees show the hereditary tendencies to otosclerosis in families which I have been able to follow for years and in whom I have examined most of the members. The other members who were deaf presumably also suffered from

otosclerosis, for in some who had died the diagnosis was made by aurists, and in the cultivated families the characteristics of this disease were also noticed by the laymen, namely, the progressive course, the tinnitus in the beginning, the onset or aggravation during pregnancy, the absence of pain and suppuration.

In the five families there were eight, eight, three, eight, and sixteen, altogether forty-three cases of otosclerosis. Of these seventeen were males and twenty-six females. Without apparent heredity the otosclerosis appeared in seven; seventeen became affected in the second generation; twelve became affected in the third generation, though in my cases, at least, the ages of the patients showed them to be too young to become affected; seven became affected in the fourth generation.

The inheritance in the youngest generation of this last family occurred from parents both of whom suffered from otosclerosis and were consanguineous. The transmission occurred to all the seven children. Otherwise, one of the parents transmitted the condition to the children, from the father ten times, from the mother eighteen times, from the father and mother seven times.

The inheritance occurred from father to son five times, from father to daughter five times, from mother to son nine times, from mother to daughter nine times, from father and mother to son twice, from father and mother to daughter five times.

Of the children who were predisposed to otosclerosis through heredity, thirteen were first-born, six were second-born, seven were third-born, five were fourth-born, two were fifth-born, two were sixth-born, three were seventh-born, two were eighth-born, one was ninth-born.

How can we explain the nature of otosclerosis from these hereditary conditions? Before answering this question it is necessary to briefly give the laws of biological heredity and their importance for pathology. These are taken from the illuminating remarks of Martius, Professor of Medicine in Rostock.

The children inherit, or the parents transmit, only those

peculiarities or their material substrata which are contained as rudiments in the germ plasma of the parental sexual cells. The union of the ovum and the sperm cell completes the act of inheritance. The inherited material substrata of the parental germ cells are called determinants, according to Weismann. The unusual number of determinants do not alone originate in the plasma of the parents but from the collected ancestral plasma. They may be transmitted from one individual to the progeny without ever having become active in that individual or in part without ever having become later active. What is not contained in the determinants no external influence can add to the individual germ plasma which is complete after the germ union.

This has the following bearing on pathology.

The predisposition to disease may exist as a determinant and be heritable. A disease rudiment (disposition) and an external (exogenic) cause as an infection may produce disease, but this acquired disease cannot be transmitted to progeny with the germ cells. In other words, it is not heritable. It is, therefore, incorrect to speak of hereditary diseases. The term hereditary syphilis is incorrect. It is usually congenital because it is transmitted from the mother to the foetus through the placental circulation.

That diseases cannot be inherited is evident if we realize that they do not represent conditions or peculiarities, but events which are of no significance for the formation of the individual. These events can naturally not be contained in the germ plasma. It would seem that hemophilia is a disease which would negative the correctness of this theory, but hemophilia is no occurrence—in other words, no disease, but it consists in a peculiarity of the blood which was given by a determinant, and is therefore heritable, the characteristic of the blood being that it has lost its tendency to coagulate. From this inherited individual defect hemophilia occurs if, through some external process like injury, conditions are furnished which present the insufficient coagulability of the blood.

Let us now return to otosclerosis.

As diseases cannot be inherited, and as otosclerosis is

inherited, it would seem that it is no disease, at least not in the above exact and scientific sense. Otosclerosis would be a disease and a congenital one, but not a hereditary one if it were of syphilitic origin as Habermann assumes. The following are the reasons for this assumption of Habermann's:

Among thirty cases of otosclerosis the etiology seemed certain in four, almost certain in one. In the other cases syphilis could not be excluded with certainty.

To this may be replied, that the syphilitic origin of sclerosis has not been demonstrated in a single case of Habermann's thirty cases, because the onset of sclerosis in a syphilitic person does not show any causal relation of the two diseases, but only a coincidence which may be accidental. If syphilis was present in only four or five out of thirty, then, given the frequency of syphilis and the rarity of otosclerosis, it would seem that otosclerosis cannot be syphilitic. That syphilis was the cause in the remaining twenty-six cases may, of course, be correct. If Habermann assumes that syphilis is the cause, to prove his hypothesis he must therefore prove that every sickness is syphilitic.

A further proof offered by Habermann is that otosclerosis occurs generally between the ages of twenty and forty to fifty years, a period in which syphilis is most frequently acquired. It may also be mentioned that carcinoma occurs most frequently at this age without stating that it is of syphilitic origin. I doubt very much the correctness of this age for the most frequent onset of otosclerosis. It is quite true that most of those suffering from otosclerosis seek aid in those years, but E. Hartmann years ago has shown that the onset of this extremely insidious trouble probably occurs at a much earlier age. In reality an early onset of otosclerosis is not rare, for in the three families which I have observed in the last generation one was affected at the age of ten, one at fifteen, and the other three before the twentieth year. In literature early examples of this disease have been mentioned by Bezold and Scheibe.

Furthermore, the statement of Habermann is not convincing, that the kind of changes in the bone found in oto-



sclerosis are syphilitic in character. Finally the question can be decided from the clinical side, to which we now turn.

Here we find a number of features which argue against syphilis. If we examine the family trees we are immediately struck with the large number of children these deaf people have had—namely, four times 10, once 9, three times 7, four times 5, three times 4 and 3, twice 2, and only once 1—on an average 5.5. My second deaf family shows an unusual longevity, and infant mortality plays no rôle in these families, and deaths in the first months have not occurred. These are, of course, all opposed to the conditions found in syphilitic families. On examination of the deaf patients and of the other members of their families, I have observed only one case of tabes and sclerosis, who had had ten healthy children.

Siebenmann also opposes Habermann's hypothesis. He has had the family histories of the various cases of sclerosis which he has examined carefully gone over without finding any trace of syphilis.

If, therefore, sclerosis is not a disease, in the truly scientific meaning of the word, how are we else to regard it? The answer is furnished by the interesting pathological investigations of Siebenmann.

We call otosclerosis that form of progressive deafness which pathologically rests upon a hyperostotic new formation of bone in the labyrinth windows, thus fixing the stapes in the oval window, and the rarefaction of the otherwise compact labyrinth capsule. Though many authors believe that these changes are derived from an ossifying periostitis following an infection of the mucous membrane in the tympanum, Siebenmann concludes that this is incorrect, and that the oldest parts of the process are to be found at the periphery of the primary labyrinth capsule, and the connective tissue bone secondarily developed from the periosteum. He regards the rarefaction in the last phase as a developmental process, which normally does not occur in the petrous bone, but is the rule in other bones, and consists in a complete disturbance of the cartilage situated in the inter-



globular space and in the window margins, and the transformation of the compact bone into osteoid tissue and finally into spongiosa.

This interpretation of Siebenmann's of otosclerosis as an abnormal post-embryonal development proves the fact of its hereditary nature. Every stage of growth, whether normal or abnormal, must be furnished in a determinant transmitted from the ancestral plasma of the individual, and is therefore heritable. Whether the determinants become active may in our cases depend upon certain influences of an internal or external nature. Clinically, we have seen that the onset of puberty, which is probably the greatest incentive to bony growth, and the childbed, which also causes changes in the bony system, may be regarded as exciting causes. In rare cases a disease of the tympanic mucous membrane may have some influence in causing the abnormal development.

How can we explain the cases of otosclerosis in which there is no heredity? Our law of inheritance again helps us out.

The normal determinants which preserve the species are constantly transmitted. If this did not take place man would have degenerated long ago, or even have disappeared from the earth. The determinants which represent individual characteristics are different. These are inherited, but do not become active in each successive generation, but may skip a child, and then again appear in a grandchild. Thus the grandchildren frequently resemble their grandparents more than they do their parents. The determinants in these cases have remained inactive for several series of generations, then suddenly recur to activity. This is spoken of as latent inheritance.

We must also remember the many determinants which are collected in the ancestral plasma of each individual. In twelve generations we have 4096 forefathers, if we disregard the loss of ancestors through consanguineous marriages. If we therefore assume that the otosclerosis determinant must be present in the ancestral plasma of each person, after generations it may suddenly become active and destroy the happiness of an entire family.

The apparently spontaneous causes of otosclerosis can therefore easily be expressed by latent inheritance. It would, of course, be difficult in these cases to discover the determinants, because the ancestral trees can be followed in most persons to hardly three generations.

The law of inheritance explains the character of otosclerosis as an inherited abnormal process of development. When and how it occurred in our ancestral plasma is, of course, not known. The presence of heredity, as Hamerschlag has correctly said, simply pushes the question back to the original cause, which is unfortunately at an infinite distance.

Though the light which the theory of inheritance throws upon the nature of otosclerosis is slight, we nevertheless receive more information as regards the prophylaxis and treatment of progressive deafness. When the determinant of the abnormal development has become active, every hope of successfully combating this affection must be regarded as futile. The prophylaxis is somewhat more encouraging. We may accomplish something by advising the person who is suffering from otosclerosis not to marry so that he will carry with him to the grave his determinants. In the female descendants of one suffering from otosclerosis who are not deaf, the advice not to marry is especially important, because every pregnancy is apt to incite the latent determinant into action. Conscientious physicians have followed this course on the basis of experience. We may now give this advice with greater emphasis because it rests upon a biological law.

## THE THEORY OF SOUND-CONDUCTION.

BY DR. GEORG BOENNINGHAUS, BRESLAU.

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IT is now about a year since I published my attempt to explain the theory of sound-conduction by a new method, namely, by means of comparative anatomy, and selected the ear of the whale as being most suited for this purpose. Numerous criticisms have appeared. Some of these consist simply of reviews, others are expressions of opinion in meetings, but it is especially the paper of Bezold, in the first and second numbers of the forty-eighth volume of this *Zeitschrift*, on "Further Investigations on Bone-Conduction," etc., which has induced me to publish the following:

### I.

The only review which is at all critical is that of Eschweiler in vol. xlvii., No. 1, of this *Zeitschrift*. This writer believes that I have passed over certain objections too quickly. The objections, however, are not mentioned, so that I can only reply that my conclusions coincide with the standpoint of our physical knowledge on sound and sound-conduction, and support the physiological and clinical aspect of sound-conduction in the ear in a most objective and critical manner.

This writer also accuses me of thinking in too teleologic a manner in the department of comparative anatomy and phylogensis, but in this I cannot agree with him. In my opinion he believes that I depend upon the standpoint taught by Kant and developed by Darwin for the organic world, that

things may be explained by a mechanical cause originating from the causal necessity which Darwin represents as the struggle for existence, but that in this struggle, expressed generally, the necessary members are preserved and correspondingly changed for their purpose, but the unnecessary ones, however, are lost. This form of teleologic reasoning is entirely justified, and represents the guiding star for thousands of workers in this field of biologic research. I surely have not gone too far as regards the main facts. The principal idea of my paper is as follows: The whale is a mammal which was originally possessed of organs, such as legs and hair, which serve for life on land—in other words, one of the original land mammals,—and which then, as has generally been accepted, in the struggle for existence, on account of the pressure of lack of food, variations in temperature, or from attack, abandoned life on the land and adopted continuous residence in water. Then the organs which are unnecessary for life in the water, as the hair, the posterior extremities, and, of the nerves, the olfactory, were lost. The useful ones, however, were preserved as far as it was necessary, and were modified to adapt them for their new environment. Thus the eye has been changed and has become a fish eye, and the ear has been modified. The purpose of the Kent-Darwin teleology is to determine to what degree this transformation of the ear is adapted for its new surroundings. The conclusions which I endeavor to draw from the simple conditions in the whale to explain the more complicated conditions in the land mammals and in man, which of course represent the true worth of the paper for human physiology and for otology, are no longer teleologic, but are simply logical deductions.

## II.

The point about which the entire theory of sound-conduction rotates, according to my idea, is the question whether the vibrations of the basilar fibres, which, according to Helmholtz's theory, are regarded as the adequate irritants of the auditory nerve terminals, are set in motion by the movements of the water column in the labyrinth in a mechanical

manner (mass movement), or by means of molecular waves which traverse the labyrinth water, and by addition of this molecular impulse are set in vibration just as tense strings co-vibrate (molecular movement). These two possibilities must be considered, because, by the impulse of the plate of the stapes in the labyrinth, not only mass movements of its water take place in the given sense, but also molecular movements are produced, according to the kind of sound waves. If one favors the mass movement, the old theory, then the entire knowledge of sound-conduction, including the function of the tympanic muscles and the prolongation of bone-conduction in disturbances of sound-conduction, remains an unsolved and improbable riddle. If the molecular movement be adopted, we then have a guide which alone will conduct us through this chaos without incurring any improbabilities or contradictions.

It must first be taken for granted that the distinction between molecular movement and mass movement, as was first suggested by Müller, should be thoroughly understood. It must also be accepted that one of these forms of motion can be transformed into the other. These two premises do not hold for medical men in general because of their slight education in physics. The frequent transition of mass movements into molecular movements, and *vice versa*, can be illustrated by ordinary events of the daily life. The blow of a hammer against a stone converts the mass movement of the hammer to sound, heat, and light. The mass movement is then entirely lost if the stone remains stationary. It is, however, in part lost and in part transmitted to the stone if the latter is not fixed. In our modern electric-power appliances, mass movements are converted into electricity, electricity then into light, or again into mass movements. A window pane which is not firmly fastened, a tuning-fork, a tense string, will be converted by a suitable tone into movements, vibrations, resonance—the conversion of sound into mass movements. Tense membranes, telephone plates, phonograph plates, vibrate to all sounds. The drum does this in the most complete manner, even to whisper. String instruments, drums, tuning-forks, when

struck, produce sound-transmission of mass movements into molecular movements. If the medium which surrounds the source of sound is movable, then the mass movements will be transmitted to the surrounding media. If I hold a vibrating tuning-fork so that one blade is in water, sound is produced which can be heard in the water, and, in addition, the water in its immediate neighborhood is transformed into distinct mass movements. If the vibrating drum forces the stapes which has been set in motion into the labyrinth water, then the displaced labyrinth water must receive a twofold movement, a mass movement consisting in a motion of the water column between the stapes and the round window, and a molecular movement which is similar to the molecular movement of sound.

### III.

My view that the basilar fibres are caused to vibrate by molecular motion rests upon the fact that the labyrinth of the whale, this water mammal which constantly swims with its ear under water, hears everything well which occurs in the water about it when it is acted upon by the molecular movement. The reason for this is that the stapes of the whale is so firm in the oval window that the necessary force which would be required to make it move in the direction of the labyrinth cavity is inconceivable. The stapes is consequently physiologically immobile. Bezold, however, is of a different opinion. I shall endeavor to ascertain which opinion seems the more probable. To show that the stapes of the whale is movable and consequently that the vibrations of the basilar fibres in the whale just as in the land mammals are set in motion by mass movements, Bezold advances the following reasons: We both regard the attachment of the processus folii of the hammer to the tympanicum of the whale as bony and therefore immobile. We may therefore disregard the mass movement of the hammer and the drum as agents in moving the stapes. Bezold, however, assumes that a moderate degree of mobility exists in the synchondrosis between the hammer and the incus, the incus and the stapes,



and the stapes and the oval window. This has not been proven by Bezold, and I have not been able to detect the slightest degree of mobility under a magnifying-glass if I pressed with a needle against the ossicular chain. The possibility of movement, according to Bezold, in these joints exists because the connection is a cartilaginous one, but this junction, to my mind, may be even firmer than the bone itself, for in one species of whale if one presses on the head of the hammer or the body of the incus of this animal then the line of fracture is not the hammer, incus, the malleo-incudal articulation, but rather the processus folii and the synchondrosis between the incus and the stapes. This is, however, not so important because in the physiological action of the stapes the force acts not in a transverse but in a longitudinal direction. If we exert a pressure in this direction with a needle on the head of the stapes no movement of the labyrinth water can be detected, which is, of course, the opposite of the conditions in the land mammals. The immobility of the stapes is caused by cartilage which attaches its unyielding flat foot-plate to the margin of the round window and also because its posterior margin rests upon a peculiar bony projection of the labyrinth vestibule. This synchondrosis of the stapes and foot-plate is so firm that even in a macerated specimen the stapes can only be removed out of its window by considerable effort. Is it probable that the sound waves of the water can cause mass movements in the stapes of the whale that thereby produce vibrations of the basilar fibres? Bezold believes that this is possible because the sound waves in the water cause the head of the whale to co-vibrate so that the stapes must also move. We have learned from the experiments of Müller for the fish-bladder, Dennert for the tuning-fork, and Kayser for the telephone plate, that bodies in water may be caused to co-vibrate by sound waves in the water. It seems to me very improbable, however, that such an enormous structure as the skull of a whale, which is in turn covered by fat almost a metre in thickness, can be so easily caused to vibrate. Notwithstanding the ready transmission of sound waves to solid bodies in water, this is to a certain extent equalized by the

increased resistance which the surrounding water exerts against vibration. This resistance is readily understood by the rapid dying out of tuning-forks in water. The intensity of sound, therefore, in water must be unusually great to be brought to perception in this manner in the case of the whale. Such might be the advancing roar of the beach, but if the whale was not able to hear anything but this, he would be very poorly off. He must be able to appreciate noises which emanate from smaller animals. These are the respiratory noises, the blowing of the tail, and the voice so far as this is present. In the absence of the sense of smell and touch which is so highly developed in the fishes, and the slight value of the eye in water on account of the slight degree of light, this alone makes it possible for them to find their own kind, and it seems probable that an extremely delicate hearing alone makes existence possible for the whale. This high development of the hearing is especially apparent from the remarkable acoustic isolation of its labyrinth. These reasons all lead me to believe that the basilar fibres can hardly be made to vibrate by mass movements of the labyrinth fluid.

Bezold further believes that the movements of the stapes are accentuated in the following manner: The tympanic bone in the whale is attached to the outer surface of the temporal bone. The vibrations of the stapes and of the incus cause the bones to feather just as the vibrating string of a musical instrument causes the resounding box to vibrate. The vibrations of the bony resonance box in the whale in turn increase the vibrations of the bony strings of the incus and stapes. The possibility of this feathering, however, seems to me very slight if one considers the enormous size of the tympanic and temporal bone in a whale. I must confess that the relatively thin tympanic bone of the phocæna, of the porpoise, and of the narwhale can be made to feather on heavy pressure with the finger. He also believes that this action of both bones is supported by the tensor tympani muscle, and believes this explains the persistence of this muscle, notwithstanding the mobilization of the hammer. This, however, can be explained by the fact that muscles, after they have once been developed, even if they have

lost their function do not need disappear. The muscles of the auricle in man are an example of this.

Bezold speaks of another form of sound-transmission in the whale. On striking various parts of the tympano-perioticum with a metal hammer, various tones were produced which embraced the larger part of the tone scale. The employment of this phenomenon to explain the theory of sound-conduction in the whale has, however, great difficulty and Bezold does not go into it very deeply. I consider this phenomenon as an incidental one and without importance.

Finally, Bezold observes in the shell-like form of the whale bulla an important organ for sound-conduction because each shell, like the sea-shells, possesses remarkably good resonance. The shell-shape bulla of the whale resulted from the fact that the margin of the tympanicum did not adhere to the perioticum, the purpose of which I believed to find in the resulting acoustic isolation to prevent an interference of the sound waves. A sea-shell only resounds if it is filled with air; if it is only partly filled with cotton, it no longer acts as a resonant. The whale bulla is filled with an unusually thick mucous membrane and a peculiar venous body, so that its resonance is made improbable.

Aside from these two last points, it is readily observed what enormous difficulties one encounters in endeavoring to explain the movements of the stapes by mass movements of the labyrinth fluid for the purpose of exciting the basilar fibres. The condition becomes simple and physically evident if we regard molecular passage of the labyrinth water in the whale as the exciting factor of the basilar fibres. In the whale the sound waves of the water are transmitted by molecular movement to the oval window by means of the immobile ossicles, which can be regarded physically as a sound-conducting rod with a large sound tunnel at one extremity.

Bezold opposes the probability of molecular conduction in the whale for the following reasons:

He thinks that the presence of cartilage in the ossicular chain in the whale does not facilitate molecular conduction of sound. It is quite true that every variation of density reduces the conducting power of a body, but this reduction

cannot be marked in the case of the whale because even in rods which are glued together the conduction remains good. The presence of cartilage at places which formerly were movable is explained by the descent of the whale from its progenitors, which were land dwellers. We find in the whale embryo articular fissures, and this again proves the old truth which Hackel has mentioned, that the embryology of an animal is a short recapitulation of its progenitors.

Bezold further states that if the sound-conduction to the labyrinth in the whale be regarded as molecular then the sound-conducting chain is entirely superfluous and its progressive development in a physical sense is incomprehensible. The broad communication of the tympanicum with the external surface of the perioticum suffices to transmit the sound to the labyrinth. I need simply mention again that it is not indifferent at which part the sound waves enter the labyrinth for the purpose of exciting the basilar fibres. The greatest excitation presupposes the entrance of sound waves to the labyrinth through the oval window.

Bezold does not lay any particular importance on the synchondrosis of the joints in the whale because the partial or even complete absence of articular fissures is also found in man. I should like to reply to this by stating that a synchondrosis alone is not the principal distinction between water and land mammals, but a synchondrosis which leads to immobility of the articular connections. A spring synchondrosis and an immobile synchondrosis, these are the principal physical differences, especially in the region of the oval window. The same condition is found at the processus folii. In the whale the processus folii is constantly adherent to the tympanicum. That, however, does not prevent the vibration of the hammer because the process is so thin and pliable that the hammer has almost the same degree of mobility as if it were not adherent to the processus folii. In the whale the adherent processus is, however, so thick that mobility of the hammer can be excluded.

This more or less finishes Bezold's criticisms. I have observed their appearance with great satisfaction because they recognize the importance of the whale ear for the study of

sound-conduction in general, and I trust that this same method will be followed by others. It will be extremely valuable if optical graphical methods, as have been applied in the mammalian ear by Politzer and others, are employed to study the vibrations of the sound-conducting apparatus of the whale-head in water when the sound is conducted through the water. For those who are desirous of studying this condition in the *Phocæna communis*, a small tooth-whale, I have obtained my material from Bernhard Nehls, Croslin in the Baltic. They are captured in April and cost four marks per head.

IV.

The supposition that the basilar membrane is caused to vibrate by molecular movements communicated to the labyrinth water by the stapes leads us to an explanation of the prolongation of bone-conduction in disturbances of sound-conduction. The following remarks supplement my paper to the Congress of German Otologists in Wiesbaden.

Two motions arise from the handle of a vibrating tuning-fork. The one is molecular motion, sound, audible when the handle of the fork is held in front of the ear. The other is mass movement, which is perceived by a concussion of the head. Not only the last but also the first passes through the head on account of its good conducting power by means of simple molecular conduction. Both motions must be transmitted to the sound-conducting apparatus, first, because the apparatus is unusually sensitive, and, secondly, because all media conduct sound more or less well. The sound-conducting apparatus is placed in motion by the mass movements in the same way as when it is set in motion from air. The stapes presses in the same manner upon the labyrinth water and causes a small molecular movement. The molecular movement which is transmitted by the bone when it arrives at the stapes plate continues in the direction from without inwards and gives the labyrinth water the same movement towards the basilar membrane as the molecular waves produce by the action of the stapes. These two motions are augmented by addition. In all middle-ear pro-



cesses, as Bezold has shown, the sound-conducting apparatus is immobile. The simple molecular transmission by means of the bone to the apparatus and to the stapes is therefore facilitated. The mass movement of the apparatus, however, is diminished. If under these conditions the tuning-fork is perceived longer from the bone than through air, this can only be the result of the improved transmission of molecular movement and not of diminished mass movement.

Thus Bezold's paper on bone-conduction forces me to make a modification in this description of the prolongation of bone-conduction, but the final result remains the same, that the prolongation of bone-conduction can only be explained by assumption of the molecular irritation of the basilar fibres.

Bezold is also of the opinion that from the handle of a vibrating tuning-fork two forms of motion are imparted to the bones of the skull. The mass movement causes the skull and, of course, the highly sensitive sound-conducting apparatus to vibrate. This can only be produced by molecular motion, for when it has passed the drum membrane it acts just as the sound-airwaves. The drum membrane and the ossicles are caused to vibrate in mass movement. This is surely correct, but the two impulses which cause the drum to move do not augment one another, but, to a certain extent, interfere, for, while the drum membrane receives the inclination to vibrate inwards by the molecular power, the concussion of the bone gives it an inclination to vibrate outwards. If these two impulses are the same, then the sound-conducting apparatus must stand still. But experiments have shown that the drum membrane is caused to vibrate by a tuning-fork placed upon the skull. One impulse must therefore preponderate. The motion of the drum produced from the skull must be smaller than the motion which the drum receives from the air, and so Bezold attempts to explain why sound-conduction is greater than bone-conduction in the normal ear.

This movement and contra-movement cannot be denied physically, though there is a second means of explaining the preponderance of sound-conduction. The auditory canal



may receive the sound waves from the handle of a fork held in its proximity, and conduct them to the drum membrane, while the vibrating fork placed on the bone can send a part only of its sound waves to the sound-conducting apparatus because there is no corresponding receiving tube.

From these ideas Bezold believes to have explained the prolongation of bone-conduction in middle-ear processes. I must, however, oppose this. Bezold believes that fixation of the sound-conducting apparatus is diminished by the contra-movements of the apparatus from concussion of the skull; the molecular movement, however, is not because by the fixation the molecular transmission of sound waves from the bone is augmented, so that it is clear that the vibrations of the apparatus are greater, and not less. Of the two impulses which are transmitted to the drum membrane as the cause of fixation, one remains equally strong, or may even be increased, while the other is diminished. The remainder of the impulse which remains after subtraction of the movements must in each case be greater than in an immobile apparatus, and this explains the prolongation of bone-conduction in fixation.

There is one premise in this theory which is not quite correct, and that is the molecular vibrations of the apparatus, for experiments in the living and in the skull have shown that by artificial immobilization of the apparatus the entire movement of the apparatus is reduced. Moreover, we find in otology cases in which a movement of the apparatus by co-vibration can be excluded. These are cases of complete obstruction of the canal up to the drum membrane with adherent cerumen or complete filling of the tympanum with exudate. Notwithstanding, in these cases bone-conduction is distinctly prolonged. In other words, the movement of the drum membrane in fixation is reduced, and the explanation of Bezold does not hold true which presupposes at least an undiminished vibration of this membrane.

Accepting Bezold's molecular movement of the sound-conducting apparatus from the bone, and accepting Bezold's contra-movement, which aids in prolonging sound-conduction, though it is not sufficient to explain this

phenomenon, I have come to the following explanation for prolonged bone-conduction in obstructions of the sound-conducting apparatus:

In the normal ear a certain amount of sound intensity is transferred by simple conduction by the tuning-fork handle through the bone to the sound-conducting apparatus. A small part remains in the apparatus as molecular movement. This is probably the part which is transmitted to parts which do not vibrate—for instance, to the anvil, then the ligament of the short process, and presumably to the hammer. The largest part of the sound intensity, namely, all sound waves which pass from the tympanic sulcus to the drum, and pass through the annular ligament to the stapes, are not perceived as molecular movements in the apparatus, but are transformed just as if they came from the air in mass movements in the sense of Bezold. In this same sense the stapes is thrust against the labyrinth water, and there causes molecular waves which, augmented by the waves transmitted from the bone, attain the basilar membrane and cause it to vibrate. If the sound-conducting apparatus is immobile a large amount of the sound intensity must be transmitted from the bone to the apparatus. The more the fixation has reduced the vibrating power of the apparatus, the smaller is the amount of sound intensity which can cause the apparatus to vibrate. The molecular movement which is perceived in the apparatus is, however, proportionally greater, and is transferred by the stapes to the labyrinth water. Whether the molecular intensity thus transferred to the labyrinth water is greater than that which is lost by the reduced concussion of the stapes in the labyrinth water, is unknown. The assumption that the former is greater than the latter seems probable. This, to my mind, is the only conclusive explanation of the prolonged bone-conduction in fixation of the sound-conduction apparatus.

#### CONCLUSION.

In order to understand in what way the weakest sound waves can excite the auditory nerve of the mammal, and then explain the wonderful development of its sound-con-

ducting apparatus, it is necessary for us to divide the complicated mechanism into a number of component parts, and to compare them with corresponding physical instruments. On the basis of the physical principle expressed in these instruments, we obtain the following conditions for the land mammals and man in one set, and the water mammals and the whale in the other.

The amplitude of certain sound waves which are to reach the basilar membrane can be favorably influenced as follows :

- I. Collection of the sound waves by means of a sound funnel.
  1. In land mammals and in man, in the auricle.
  2. In the whale, by means of the funnel-shaped depression on the outer surface of the tympanic bone to which the processus folii of the hammer is adherent at its apex (to transmit sound directly to the ossicular chain, excluding the auricle, auditory canal, and drum membrane, because the former are rudimentary in the whale, and the latter is separated from the hammer).
- II. Keeping the sound waves together as in a sound tube.
  1. In land mammals and in man, by
    - (a) The external auditory canal.
    - (b) The bony cochlear canal.
  2. In the whale, by means of the tubular bony vestibule and the bony cochlear tube.
- III. Transmission of sound waves of the air to the labyrinth water by including a machine driven by the sound as a motor.
  1. In land mammals and in man, in the form of
    - (a) The drum membrane according to the plate of the phonograph ; superior to it, however, in facility of vibration, because the tense membrane is of a string-like structure, and force of impact against the ossicular chain on account of the curve of its radial fibres externally. The result of this is a transformation of the sound

waves of the air into mass movements of the drum.

- (b) The ossicular chain which is connected with the drum membrane according to the style of the phonograph plate; superior to it, however, on account of its lever-like structure (von Helmholtz). (Effect: transmission of the mass movement of the drum membrane into sound waves and into sound waves of the labyrinth fluid by means of the moving ossicular chain, in the latter instance by the impact of the stapedial plate in the labyrinth fluid.)

2. In the whale, absent.

IV. Employment of the main sound ray—that means sound waves of great amplitude.

1. In the land mammals and in man.

- (a) Adaptation of the auricle by means of its muscles, thus facilitating the catching up of the sound.

- (b) Accommodation of the stapedial plate by the combined action of the tympanic muscles at that point of the ampulliform bony vestibule from which the main sound ray is reflected most intensely into the bony cochlear tube in the form of a sound thrower—that is, a rotating sound-source.

2. Absent in the whale.

V. Reduction of the obstruction to conduction.

1. In land mammals and man, absent—pathologically present in sound-conducting obstruction, whereby the sound-conducting apparatus is immobilized, though only applicable in direct conduction of sound to bone.

2. In the case of the whale, by means of the immobile, thickened ossicular chain according to a sound rod.

VI. Acoustic isolation—that is, the keeping off of accessory sound waves which would interfere with the sound waves on their way to the basilar membrane. This is not employed in physical instruments.

1. In land mammals and in man.
  - (a) By surrounding the labyrinth with air space.
  - (b) By the density of the bony labyrinth capsule.
  - (c) Irregularity of the walls of the air spaces, especially of the tympanum.
  - (d) Deflection of the round window backwards and the presence of a partition wall between the auditory canal and the round window. This prevents sound waves penetrating from the auditory canal and from the round window into the labyrinth fluid.
2. In the whale, by means of
  - (a) Increased extent of the air space surrounding the labyrinth.
  - (b) Increased density of the labyrinth capsule.
  - (c) Distention of the tympanum with a peculiar body.
  - (d) Occlusion of the niche of the round window with soft parts.
  - (e) Partial separation of the tympanum from the temporal bone, thus diminishing the direct transmission of sound waves from the first bone to the second.

This short resumé shows us the necessity of a compact machine in the ear of the land mammals and of man to transmit the sound in its original intensity to the labyrinth fluid, a condition which cannot be solved by simple molecular transmission. It also shows us the simple form, namely, that of a rod, to which this highly developed mechanism in the water-animals can be reduced, because in these a similar difficulty in the transmission of the sounds of the water to the labyrinth water is not present, and a different arrangement had to be furnished to secure the acoustic isolation of the labyrinth on account of the facility with which sound from all directions in the surrounding water is collected.

THE CHANGES IN THE EYE-GROUNDS IN OTITIC  
DISEASES OF THE BRAIN, THE CEREBRAL  
MEMBRANES, AND THE SINUSES.

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(From the Ear Clinic in Rostock.)

Abridged Translation from *Zeitschr. f. Ohrenheilk.*, Vol. XLV., 1903,  
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PROFESSOR KÖRNER has previously reported on this subject in his *Mittheilungen aus den Grenzgebieten der Ohrenheilkunde*. I wish to add to the thirty-four cases which he published the more recent cases observed in the clinic in which the eye-grounds were examined and where the diagnosis was confirmed either by operation or by autopsy. Case 34 of Körner's statistics is also included in my statistics because the case had not come to a definite conclusion at the time of publication of former work.

I have divided the material according to the kind of intracranial disease and have separated the cases with one from those in which several complications were present. It is evident that we obtain more information as to the diagnostic value of the changes in the eye-grounds in cases of only one intracranial complication. Of the complicated cases each case is introduced only once in the table. The table shows us that changes in the eye-grounds in otitic suppurations within the skull are more frequently absent than present. We find them present in only 16 out of 54 cases. We further find that a single intracranial complication more rarely caused changes in the eye-grounds (6 in 37 cases) than the combination of several complications (10 in 14 cases).

The changes in the head of the optic nerve in sixteen cases



were bilateral in fifteen, though the original affection was one-sided. In one case the optic nerve on the same side as the diseased ear was affected. Both optic nerves showed changes to the same degree in six cases. The optic nerve was more affected on the side of the ear disease in five cases and less affected in four. The prognosis of intracranial affection is not influenced by the presence or absence of changes of the eye-grounds.

The time after which the optic-nerve affection disappeared after the intracranial suppuration had run its course could be determined in five cases. The severe changes in two cases had disappeared after fifty and fifty-four days. In one case the optic neuritis recovered in thirteen days on one side and in twenty-four days on the other. In another case the recovery took place in twenty days and in still another in fourteen days.

As a rule, a few days after the evacuation of the pus from the cavity there is a distinct improvement of the optic-nerve affection. In one case the symptoms diminished after the evacuation of an abscess of the temporal lobe, but became again more severe three weeks later with signs of meningo-encephalitis.

The increase of the neuritis after the suppuration in the cranial cavity has been eradicated does not necessarily mean an unfavorable prognosis. In one of our cases this symptom was observed and the patient recovered without further operation. In one case, previously mentioned, the neuritis had diminished after operation, then became more marked without any local or general disturbance in the condition of the patient. In one case which was more remarkable the changes in the optic nerve set in after the operation. They became more severe, and then disappeared without another operation being undertaken. Three other cases were similar to this one in this regard. These were all children who suffered, with one exception, from the same intracranial suppuration. In one case the changes in the eye-grounds increased after the operation. In another case the eye-grounds before and after the operation were always found

normal until the thirty-first day after the operation when changes in the optic discs were observed.

How can the increase or the presence of optic neuritis be explained after the operation in cases where, notwithstanding these new symptoms, the patients recovered without further operation? As is well-known, otologic literature contains many examples of these diagnostically unexplained cases with more or less well-developed brain symptoms that disappear in part without an operation. In many of these cases the changes were found in the eye-grounds. Occasionally these unusual observations were regarded as examples of serous meningitis or as œdema of the brain and hyperæmia. According to Professor Körner, in these cases there is probably a mild toxic non-bacterial meningo-encephalitis originating from the purulent focus in the temporal bone.

In the cases with only one intracranial complication, the following may be said as regards the condition of the eyes.

In the extradural abscesses, if they are not large enough to compress the brain or the sinus, no disease of the optic nerves will be observed. In our twenty-two cases they were absent in eighteen, and in Hansen's statistics of eleven cases in nine.

Of great interest is the condition of the optic nerves in purulent meningitis. It was formerly stated that this severe suppuration which extends over large areas at the base of the convexity, occasionally into the ventricles, always produced changes in the optic nerves. This, however, does not agree with the facts. Though Knies regards optic neuritis as one of the main diagnostic symptoms of purulent leptomeningitis, Pitt, as a result of his investigations in Guy's Hospital, found that the changes in the optic nerves in uncomplicated otitic purulent meningitis were always absent. He believes that the duration of the disease in his cases was too short for the development of neuritis. Barnick is of the same opinion. Our six uncomplicated cases had normal optic discs up to the time of death. Of the eight complicated cases two had no changes in the eye-grounds. In the remaining six there were changes. Hansen found in fourteen uncomplicated cases six without neuritis and eight with changes in the optic nerves.

Uncomplicated phlebothrombosis of the transverse sinus in our five cases caused changes in the discs in one case; in Hansen's eight cases in three. One-sided occlusion of the cranial sinuses does not seem to suffice to produce congestion of the back of the eye. In the gradual occlusion a sufficient collateral circulation must be thought of.

An uncomplicated abscess in the temporal lobe and a cerebral abscess complicated with an extradural suppuration showed no changes in the eye-grounds. In a complicated abscess of the temporal lobe, optic neuritis was present at the time at which the complicating meningo-encephalitis had probably not as yet set in. In Case 36, in which the eye-grounds were examined directly before the operation and found normal on the third day after operation (three days before death), changes were found in the optic nerves, though the brain-abscess had probably been complicated from the first with a progressive encephalitis. In a cerebellar abscess complicated with obliteration of the transverse sinus and meningitis, changes were found in the eye-grounds. Hansen found these changes in only one-half of the abscesses of the temporal lobe and one-third of the cerebellar abscesses.

The deductions which can be drawn from this material should of course not be considered final. We nevertheless think that the following points can be emphasized:

1. Changes in the optic nerves may be absent in any intracranial complication of aural and temporal bone suppurations.
2. They are more frequent in a combination of various kinds than when only one of the possible intracranial complications is present.
3. The more marked development of the eye-ground changes on one side does not prove the exclusive involvement or greater development of the original disease on the same side of the skull.
4. Changes in the optic nerves do not furnish aid in prognosis. The appearance or increase of the neuro-retinitis after evacuation of the pus from the cranial cavity does not of itself render the prognosis more unfavorable.

ON THE OCCURRENCE AND ABSENCE OF  
CROSSED PARALYSES AND DISTURBANCES  
OF SPEECH IN OTITIC SUPPURATIONS OF  
THE BRAIN AND MENINGES.

BY DR. TAKABATAKE, JAPAN.

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AT the twelfth annual meeting of the German Otological Society Heine reported a case where amnesic aphasia occurred with otitic brain abscess, though the abscess was situated in the right temporal lobe and the patient was right-handed. The author states that the explanation for this exceptional disturbance of speech in our case can hardly be given. The favorite distant action is questionable, owing to the smallness of the first abscess.

The discussion which followed treated the question whether the so-called distant action depended upon the size of the abscess.

Koerner said: "If I have correctly understood the speaker, he stated that at a definite time brain symptoms were present which could not be regarded as distant action on the part of the abscess, because the abscess was then too small. The so-called distant actions, however, not infrequently occur with small abscesses, and may be absent when the abscesses are very large. We must not explain their action only by mechanical means, by pressure on the surrounding tissues, because they are probably the result of an encephalitis, which starts from the abscess, and which is frequently mild and curable."

The other speakers, Passow and Hoelscher, agreed with Koerner, and spoke of pertinent cases.

The importance of this question, from the standpoints of diagnosis, prognosis, and indication for operation, has made it worth while to examine the case histories in the Rostock Ear Clinic during the past few years with a view to discovering the presence and absence of so-called distant symptoms in otitic intracranial suppurations. I shall formulate the question as follows: Are the crossed paralyses and disturbances of speech observed in otitic intracranial suppurations caused by the pressure exerted by the accumulations of pus in the neighboring centres or tracts, or are they the result of an affection of the cortical centres or of the tracts?

Of course this question is not entirely a new one. In regard to the crossed paralyses after the first successful operations for brain abscess, authors in general were inclined to restrict the generally accepted theory of the production of the crossed paralyses simply from a pressure of the abscess on its neighborhood of functional importance.

The purely mechanical explanation of crossed paralyses of the temporal lobe originated with Macewen and Von Bergmann. Both authors believe that these paralyses are due to the pressure of the abscess on the temporal lobe, which extends to the motor cortical centres. Von Bergmann bases his views on the experience that pareses are usually present in the arms of the opposite side, or are more pronounced than in the legs, and believes that this is due to the fact that the lower part of the central convolutions which contains the centre for the arms is situated contiguously to the abscess in the temporal lobe, and is, consequently, first affected.

Sahli was the first to oppose this view, and to draw attention to the fact that a greater involvement of the arm over the leg does not necessarily mean a cortical paralysis, because in very incomplete cerebral hemiplegia the leg is less affected than the arm. It seemed, therefore, that the crossed paralysis occurring in these paralyses could only be produced by an injury of the internal capsule.

This opinion was pronounced by Koerner in the first edition of his book. He says: "Von Bergmann has shown



that a growing brain abscess increases intracranial pressure in two ways: first of all, the tension of the cerebro-spinal fluid is increased everywhere where this fluid is situated, in the sinuses of the arachnoid and in the lymph spaces of the brain; furthermore, the pressure is transmitted by the firm brain substance not uniformly, so that the neighborhood of the abscess is more involved than the distant parts of the brain."

Preysing has shown that in reality increased pressure can force the region of the internal capsule out of its normal location.

Koerner states further that the inflammatory œdema, which in many cases surrounds the temporal lobe abscess, can easily extend to the internal capsule, while the central convolutions are protected by the Sylvian fissure against this force for some time, because the pia in this fissure does not become inflamed in the form of a lepto-meningitis. In addition, all disturbances which can be produced by an injury to the internal capsule may occur in an otitic abscess of the temporal lobe.

Thereupon Von Bergmann abandoned his view on the origin of crossed paralyses by direct injury of the motor cortical centres, and gives the Sahli-Koerner description in his third edition.

As direct pressure from the abscess, as well as its surrounding œdema, may produce this distant action upon the internal capsule, it is evident that the inflammatory œdema of an abscess near the internal capsule may involve the capsule before the abscess pressure is present. The presence of a crossed paralysis, therefore, does not prove that the abscess is large, but that either the abscess is large or there is an inflammatory disease of its surrounding tissues, an œdema, or, more properly, a toxic or bacterial encephalitis.

It would be interesting to determine how large an abscess must be in the temporal lobe to produce by pressure alone, without inflammatory changes, an involvement of the internal capsule. Cases which can be used in answering this question are, however, very uncommon. Koerner, in the first edition of his book, says: "I have not been able to find in



literature a case of temporal lobe abscess which has been carefully followed to its termination in which these symptoms [symptoms of an involvement of the internal capsule] have been completely absent." In the second edition a case of Grunert's is given, in which crossed paralyses apparently were absent. In the third edition, in 1902, he was able to publish one single straightforward case. The right-sided abscess had produced no cross symptoms whatever. It contained about two tablespoonfuls of pus. The slight influence which the pressure of an intracranial suppuration exerts upon the surrounding brain to produce crossed paralyses and disturbances of speech is shown by the observation of two unusually large otitic collections of pus in the skull. In one case (Lehr) there was a left-sided otitis with pseudo-cholesteatoma, which had perforated into the posterior cranial fossa. The abscess extended extradurally and posteriorly along the outer surface of the cerebellum and the occipital lobe up to the torcular Herophili, upwards to the lower third of the parietal bone, anteriorly to the squama. The dura over the temporal convolutions was destroyed. Pus had found its way into the fissure between the middle and lower temporal convolutions, and a part of the transverse sinus was necrotic. Notwithstanding, every evidence of a crossed paralysis was absent, as well as hemianopsia and disturbances of speech.

The second case reported by Koerner was an intracranial tumor complicated by an extradural suppuration. A true cholesteatoma starting from the left half of the occipital bone had perforated to the scalp and into the middle-ear cavities. In the latter place it had become infected by an influenzal otitis and suppurated. The tumor surrounded by pus was about as large as a goose's egg and forced the left cerebellar lobe, the posterior extremity of the temporal lobe, and the lower part of the occipital lobe so deep in that the compressed brain after the removal of the tumor required four weeks before it attained the level of the cranial fluid. Nevertheless there was no crossed paralysis, no hemianopsia, and no disturbance of speech.

In these two cases marked pressure on the sensory speech centre had produced no aphasia, pressure exerted on the

occipital lobes had produced no hemianopsia, and, notwithstanding that the pressure probably affected the lower motor cortical centres and presumably the internal capsule, there were no crossed paralyses.

The only explanation possible is that simple mechanical pressure is not sufficient to account for a functional disturbance of these centres and tracts and that the dura prevented the neighboring brain from becoming involved. It occurs occasionally that an otitic extradural abscess over the temporal lobe produces, without demonstrable lesions of the dura, crossed paralyses and disturbances of sensibility and, when the suppuration is on the left side, sensory disturbances of speech. In two of the three cases of this kind which Koerner has collected, the extradural abscess was of an unusually small size, so that the action of pressure does not come into account. No other explanation remains for those cases where local brain symptoms are observed in cases which get well than that suggested by Merkens, that the brain symptoms are produced by a toxic meningo-encephalitis originating in an infectious focus of pus, and heal spontaneously on evacuation of the original collection of pus.

The conditions in purulent lepto-meningitis are quite different. The cerebral symptoms of irritation and paralysis, if they are not produced by direct injury of the cranial nerves at the base, are affected from the cortical centres. It is indifferent whether this is the result of the pressure exerted by an exudate or by associated involvement of the cortex.

Professor Koerner has drawn attention to the fact that in the autopsies performed in cases of otitic meningitis marked flattening of the convolutions is observed on the convexity without a corresponding dilatation of the ventricles from increased ventricular fluid. In twelve uncomplicated cases, this observation was made in four. It seems that the hyperæmia of the meninges and the congestion of the cortex are sufficient to produce a swelling of the brain tissue, as is noticed by a flattening of the gyri and an obliteration of the sulci. It has not been determined what influence the presence or absence of these changes exerts upon the symptoms of meningitis. Of all the symptoms of otitic meningitis the motor

sensory and mixed disturbances of speech are of the greatest interest because they complicate the differential diagnosis with brain abscess, as for instance in an important case of Kuhn's in which left-sided otorrhœa was associated with a purely sensory aphasia, just as is frequently observed in brain abscesses. The motor aphasia is most frequent in meningitis, according to Koerner, and is produced by a pronounced exudate in the Sylvian fissure. The rarity of a distinct aphasic symptom-complex in otitic meningitis justifies the publication of the following case of complicated sensory motor aphasia.

B., thirty-five years old, was brought to the Clinic on March 9th. On February 23d she had suffered from vertigo, on the next day fever, headache, general prostration, pain in the limbs. Then no vertigo and no vomiting. Temperature varied, yesterday rose to  $40^{\circ}$ . Pulse retarded. Occasional pain in the left half of the head. Until yesterday there was an area about 3cm above the left auricle which was tender. An otorrhœa has existed from the left ear since childhood. On admission a large, well-built woman, temperature  $38^{\circ}$ , pulse 78. Sensorium clear. The patient answers questions correctly but appears very tired. She complains of pain in the entire left half of the head, especially in the left forehead. In the ear there is some pus. The drum is practically totally defective and no ossicles are to be seen. The tympanic mucous membrane is very red. There are no symptoms on the part of the mastoid process. A careful functional examination could not be undertaken on account of the patient's condition. Eyes normal. The fundus showed a slight congestion of the vessels. The discs are not prominent and the margins are defined. She correctly designates objects. No rigidity of the neck.

*March 10th.*—The patient is in good spirits, converses with her husband, and complains only of occasional headache. Temperature during the day rose to  $39.9^{\circ}$ ; pulse, however, did not go beyond 96. With the rise of temperature, though the sensorium remained regular and without so-called slow cerebration, a striking disturbance of speech set in. Rigidity of the neck absent. Power in the two hands preserved. No changes in the eye-grounds nor in the fields. The patient is unable to remember certain words and becomes very much excited over not being able to

find the proper term. Objects which are held before her cannot be correctly designated. Lumbar puncture evacuated a clouded fluid under pressure which contained an increased quantity of leucocytes.

*March 11th.*—During the night restless. No vomiting, no change in the fields. Ocular movements normal. Pulse normal. No facial paralysis, no rigidity of the neck. The pulse reflexes are wanting. Kernig's contracture pronounced, left more than right. Temperature remained over  $39^{\circ}$ ; pulse regular, 96. In the evening chronic convulsions in the right hand. The patient moves the head in all directions. No rigidity of the neck, no passive movements, regular pulse, and eyes normal.

*March 12th.*—During the night vomiting. Temperature  $39.9^{\circ}$ , pulse regular, respiration 44. The patient is completely aphasic. She does not protrude the tongue on being asked to do so, but follows the finger in the examination of her ocular movements. In the morning it is very distinctly to be seen that she endeavors to answer questions but is unable to do so. Reflexes and Kernig's symptom as yesterday. In the eye-grounds no change. Moderate convulsions in the right hand. Restless movements of the left leg. Towards evening there is moderate rigidity of the neck. The fluid obtained by lumbar puncture contained many diplococci with an undefined capsule in these cells. They resemble the Fränkel-Weichselbaum. On growth numerous diplo- and streptococci appear.

*March 13th.*—Conjugate deviation to the left. Pupils wide, they do not react alike. The right arm cannot be moved. With the left the patient often grasps her head. Incontinence of urine. The pulse rises rapidly to 154, respiration 72. Death at 10 P.M. No autopsy.

ETIOLOGY AND PATHOLOGY OF MASTOID  
EMPYEMA COMPLICATING ACUTE  
PURULENT OTITIS MEDIA.

By DR. A. SCHEIBE, MUNICH.

Abridged Translation, by ADOLPH O. PFINGST, M.D., Louisville, Ky., from  
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**B**ACTERIOLOGICAL, histological, and clinical study of a series of cases of disease of the temporal bone have convinced me that these cases should be classified into those associated with acute and those complicating chronic otitis media. It is a fact now generally recognized that the etiological factors in the two forms differ, the necrosis occurring in the acute cases depending upon the general condition of the patient, and seldom being met with in the healthy subject, while in the chronic cases the cause of the bone affection is purely local. The pus in cases of chronic otorrhœa is frequently under pressure, and in a state of more or less decomposition, the result of improper drainage, to which is ascribed the involvement of the bone. Exceptionally, retention of pus leads to necrosis in the acute cases, notwithstanding healthy condition of the subject.

There was a time when all destructive disease of the bone was grouped together under the general head of "caries." In late years there has been a tendency among surgeons to retain this term only for certain forms of bone disease. In the text-books on otology, much ambiguity still exists as to the exact meaning of the term. Reference to the latest works on otology shows that cases of exposed bone by necrosis of the mucous membrane of the air-cells, or by



separation of the periosteum from the bone, destruction by malignant growths, granulations of the mucous membrane of the tympanic cavity, with coincident changes occurring in the bone, are all placed in the same category. The first effort to effect a new nomenclature to differentiate between necrosis, pressure atrophy, malignant bone disease, etc., was made by Bezold eleven years ago. Since then Koerner, Bruehl, and a few others have also advocated a definite classification of these affections.

In my study of the etiology and pathology of mastoid empyema complicating acute middle-ear suppuration, I have endeavored to solve two principal questions: first, why fistulæ form in the bone in only a certain percentage of acute middle-ear inflammation, and the majority of cases end in resolution without involving the bone; and, second, to what pathological process the so-called cases of "caries" can usually be attributed. In explanation of the first question, Bezold says that the most important of the deciding factors in the encroachment of the pus on the bone is the pressure under which the pus is kept in the tympanic cavity by unfavorable conditions for drainage, such as small size or unfavorable position of the perforation in the drum, but that the position and size of the communication between the mastoid cells must also be looked upon as a factor of moment. He does not believe that the kind of micro-organism influences the liability of bone affection or the subsequent course of the disease. Koerner looks upon the late perforation of the drum as a most important element in the etiology of mastoid involvement. He attaches more importance to the virulence of the infecting element than Bezold, and also lays stress upon the general condition of the patient in this connection. Koerner also believes that the swollen mucous membrane of the tympanic cavity may encroach upon the outlet of some of the mastoid cells, thereby creating closed pus-cavities, which may remain even after subsidence of the pus formation in the tympanum.

To get a better conception of middle-ear disease and its complications, it would not be amiss to point out the conditions that exist in the middle ear in cases of closure of the



Eustachian tube. Lessened air-pressure results in sinking of the drum, hyperemia (*ex vacuo*), and a transudation of serum. This transudation never exceeds certain bounds, and differs in this sense from the exudation of an inflammatory condition which may terminate in rupture of the drum. In the transudation due to closed tube, reabsorption only follows when the patency of the tube is restored. In contradistinction to these cases, we find in the acute middle-ear inflammations due to bacterial infection an exudate thrown out varying in amount. In those cases where the drum remains intact and the tube is open, the exudate is removed by absorption. The old idea of drainage through the Eustachian tube has almost entirely been abandoned. However, the permeability of the tube has a bearing on the course of these cases in ventilating the tympanic cavity, and thereby favoring absorption. In probably half of these cases, absorption does not take place rapidly enough, and perforation of the drum follows, if not evacuated by incision. In these cases the Eustachian tube is often closed, which accounts for the slow absorption. Many of them run their course in a short time after rupture of the drum, and terminate in closure of the perforation and restoration of function. However, in a certain percentage of these cases the otorrhœa persists, notwithstanding permeability of the tube. According to Bezold, the difference in the duration of otorrhœa depends upon the size and extent of the pneumatic cells of the mastoid bone. He believes that involvement of some of the bone cells is the main if not the sole cause of a continuance of the discharge of pus from the tympanic cavity beyond the time that acute cases usually terminate.

In a small proportion of these cases, with or without persistence of the otorrhœa, and exceptionally in cases without the history of otorrhœa, a fistulous tract forms in the bone, and discharges pus on the exterior. The fistulæ form, as a rule, where peripheral pneumatic cells are present. The defect in the outer table of the bone is nearly always round, and seldom exceeds 0.5cm in diameter. In contrast to this, perforations in the inner table, into the posterior cranial

fossa, are sometimes 2 to 3cm long. The fistulæ in the outer table are nearly always plugged with granulation tissue, and they always lead to a pus cavity. Removal of the bony edges of the tract exposes an irregularly round cavity, varying in size, and filled with pus and granulation tissue. In some cases two or more tracts have been observed leading to the same cavity. The bone in the immediate vicinity of the opening is usually so soft and vascular that it can hardly be distinguished from the granulation tissue, and it can easily be removed with a curette. These cases nearly all terminate, in from three to six weeks after operation, in closure of the wound and the perforation in the drum with restoration of function. Cases of delayed healing are nearly always due to a weakened or diseased condition of the system. New fistulous tracts never develop from a cell which has been opened externally. Statistics show that fistulæ form proportionately with more frequency in adults than in children, more in the male than female, and more frequently on the left than the right side. A feature of interest and importance is the fact that fistulous tracts have never been found to lead from the tympanic cavity, and in but a single instance from the mastoid antrum. Even in cases where dehiscences were present on the floor of the tympanum, the pus usually remains within the bounds of the cavity. Whenever the pus is not under high pressure the surrounding bony structure has a tendency to become thickened and hard rather than be involved in a necrotic process.

To facilitate the bacteriological study of suppuration of the middle ear, I have made a division of **empyema complicating general diseases**, and **genuine empyema**.

In the category of genuine empyema, we can place such cases caused by peritonsillar abscess, by accidental forcing of water through the Eustachian tube, and by traumatism, or, in other words, the cases in which the general condition of the patient is good. My examinations were made by preparing three strained specimens of the pus, and staining five minutes in concentrated solution of gentian violet, decolorizing until stain is barely visible in the pus cells, and

counter-staining. According to Hasslauer's bacteriological examinations, the diplococcus of pneumonia is most frequently present in the cases of genuine empyema, the streptococcus somewhat less frequently, while the staphylococcus is present in only a small percentage of cases.

In my own examination of a limited number of cases, I was able to find the diplococcus in only 20 per cent. of cases. The infrequency of the staphylococcus has led some to attach no importance to it in the causation of acute cases. Its frequent presence in the chronic cases has, however, led to the belief that the staphylococcus is an important factor in making the acute cases chronic. While this kind of pyogenic germ may be a factor in the production of chronic cases, I believe that even with this bacterium present, acute cases do not become chronic, unless the vitality of the body is below par.

The general diseases which most frequently lead to otitis media are scarlet fever, measles, influenza, diabetes, and tuberculosis.

It is generally conceded that in the acute empyema of scarlet fever the streptococcus is nearly always present. Leutert has gone so far as to assert that the otitis of scarlet fever is never brought about by any other kind of bacteria. The streptococcus also predominates in otitis of measles. In influenza otitis the same forms are present in the same proportion as in the genuine cases, with the addition of the influenza bacillus. In tuberculous cases the streptococcus is present more frequently than the diplococcus; the same is true of the otitis complicating diabetes.

Bacteriological research has shown that the same kind of bacteria are present in uncomplicated middle-ear supuration as in those complicated with empyema of the bone.

In cases with fistula-formation, the streptococcus has been found to predominate. From my own and other bacteriological examinations, we can conclude that bacteriology has added little or nothing to our knowledge of ear disease, and we can still adhere to the conclusion of the antibacteriological period, that abscesses of the tympanic cavity and of

the mastoid cells take a different course in the healthy individual than in the debilitated or diseased.

Literature furnishes but little information regarding the microscopic changes in the bone during acute otitis media. Politzer merely speaks of an increase in round cells in the marrow spaces of the spongy bone. Preysing, who made quite a study of the bone in acute abscesses of the middle ear, was never able to find any extensive changes in the bone. Habermann, who also made researches in this line, found that the inflammatory process always started in the marrow. The marrow spaces became enlarged and filled with new-formed connective tissue and some newly formed bone lining the osseous trabeculæ.

Siebenmann describes the bone-changes as dependent upon an absorption process and also an atrophy.

I have been able to secure fourteen specimens for microscopic study. They were all taken from cases in which perforation of the cortex had occurred. Seven of the cases were of the so-called genuine variety, six occurred during the course of constitutional diseases, and in one a doubtful constitutional affection was present.

My specimens were, with a single exception, secured at the time of the operation and placed at once in the fixing solution. They were all decalcified in 3-5 % nitric acid. The best specimens were obtained by fixing in Mueller's fluid and double staining with Grenacher's hematoxylin and ammonia carmine solution. Specimens of normal bone were also submitted to examination for sake of comparison.

The cortical layer in the normal-bone specimens varied considerably in thickness, and was nearly always separated from the pneumatic cells by cancellous bone. The cortical layer was characterized externally by the irregularity of the arrangement of the bone, internally by the lamellar arrangement, the Haversian, interstitial, and fundamental lamellæ all being present. The compact bone of the mastoid was well supplied with Sharpey's fibres, which penetrated the bone from the periosteum. The pneumatic cells of the normal mastoid were lined with a delicate mucous membrane of simple squamous epithelium. The mastoid of the

child was found to differ from that of the adult only in the arrangement and size of the pneumatic cells. In the child they are smaller and some closer to the antrum than in the adult.

Of the fourteen bones removed from cases of middle-ear abscess, all but four showed decided and identical histological changes which could well be spoken of as a spongy transformation. In the ground substance of the bone, closely crowded spaces about the size of a bone corpuscle were visible. The spaces were oval or round, sometimes oblong, and in parts anastomosed so as to form canals. None of them contained bone cells, or, in fact, any kind of cell, but they were all partially or completely filled with a homogeneous or finely granular mass. The contents of the spaces did not take the hematoxylin stain, appearing in the stained specimens as pale-blue or glassy masses. The spaces were most abundant in the compact bone, but were exceptionally formed in the trabeculae of spongy bone. Between them normal lacunae containing bone cells were visible. It was noticeable in the compact bone that they were present in the fundamental and interstitial lamellae, but not in the Haversian. They frequently come in close contact with Volkmann's canals. This spongy transformed bone always formed a sharp line of demarcation at its junction with normal bone. In some portions of the bone where spaces were cut obliquely, they were continuous with normal perforations of Sharpey. In other portions normal fibres of Sharpey were seen between the spaces. These facts and the ability to trace the described spaces to the periosteum and endosteum led to the assumption that the spaces were enlarged Sharpey's canals containing inflamed and swollen fibres of Sharpey. These changes in Sharpey's fibres were noticeable only in cases in which pus had perforated the cortex of the mastoid bone. They occurred immediately after perforation had taken place, and disappeared again or, rather, returned to normal after four to twelve weeks.

Changes similar to those described have, as far as I could find, never been described before. This can be accounted for



in the fact that Sharpey's fibres are not near as abundant in other bones as they are in the mastoid, and hence have been overlooked. My specimens were submitted to a number of pathologists, among them Prof. von Ebner, of Vienna, Prof. Mollier, and others, all of whom were unfamiliar with the described changes, but were unanimous in their belief that the spaces were the outcome of changes in the perforating fibres of Sharpey. The enlargement of the spaces was evidently brought about by pressure, and not by absorption of bone by osteoclasts. We may conclude that we have had to deal with a peculiar heretofore unobserved transformation and resorption of bone which can take place only in bone containing Sharpey's fibres.

This spongy transformation of the bony ground-substance was only a forerunner of the changes in the marrow spaces and the neighboring pneumatic spaces which lead to further destruction of bone. The mucous membrane of the marrow spaces becomes very much thickened, forty- to eighty-fold, and finally transformed into granulation tissue. The blood-vessels in the periosteum in many specimens became smaller than normal, and some were found partly filled with a granular material, probably coagulated plasma. In the cases complicating constitutional affections, the thickening of the mucous membrane was less pronounced, the amount of thickening usually maintaining an inverse proportion to the gravity of the constitutional diseases.

A noteworthy histological feature of the spongy transformed bone was the absence of pus between the bone and the mucous membrane. In the parenchyma of the red marrow, increase in the cellular elements and connective tissue was a constant feature. The consequent pressure caused atrophy of the fatty tissue in the marrow, and finally also of the ground substance of the bone. Pus was not present in the marrow of any of my cases, differing in this way from cases of primary infectious osteomyelitis as it occurs in the long bones. While the changes in the mucous membrane and marrow spaces were the result of an active process, the changes in the ground substance of the bone must be looked upon as a



secondary process. In the bony wall of the empyematous cell and the neighboring marrow cells, erosion of the lacunar spaces had taken place, causing a roughness of the surface. These changes were not so frequently noticed in the spaces more remote from the pus cells. Erosion of the lacunæ resulted through the osteoclasts, as was evidenced by their presence in recent specimens, in which they were found lying in the crevices of the rough surface of the pus cavity. Some round cells of granulation tissue were also found in these crevices. A gradual dissolution of bone followed, which finally led to perforation of the bone. The spongy transformed bone soon became invaded by the exuberant tissue of the neighboring marrow spaces and pneumatic cells. At the time that the process breaks through the mastoid cortex, or frequently several days prior to this, osteogenetic cells could be found in the wall of the pus cavity and the neighboring spaces. After several days they began to form new bony tissue. Osteoblasts formed in all of the spaces surrounding the fistulous tract, new bone formation progressing rapidly.

The osteoblasts can be demonstrated for some time after the formation of the fistulæ. In one case, in which the tract had remained open for three months, osteoblasts were still abundant, but had changed their shape and position somewhat. The defects in the bone were not completely filled with new-formed bone in any of my cases.

## ON OPERATIVE TREATMENT OF PURULENT MENINGITIS.

BY PROFESSOR V. HINSBERG, Breslau.

Translated by Dr. ARNOLD KNAPP, from *Zeitschr. f. Ohrenheilk.*, Vol. L., 1905, German Edition of these ARCHIVES.

I N recent years a number of observations have appeared which show, without a doubt, that a purulent meningitis of otitic origin is not always fatal, and that occasionally after suitable treatment recovery takes place. Three years ago I collected a number of cases in which lumbar puncture showed the presence of bacteria in the cerebro-spinal fluid and in which unmistakable clinical symptoms of meningitis were present, which nevertheless recovered after the primary focus in the labyrinth had been eradicated, and others where lumbar puncture was repeatedly performed. We must assume that the infection at the time of operation had penetrated the dura and had been rendered inert by the natural immunity of the body as soon as the operation on the ear had prevented the access of fresh infection. On the other hand, there are numerous observations published where an apparently circumscribed meningitis, notwithstanding removal of the primary focus, rapidly gives rise to a diffuse and fatal meningitis. The question naturally occurs whether in these cases a favorable result could not have been obtained if the infectious focus situated within the meninges had been exposed and drained.

The experience of general surgeons in the treatment of complicated fractures of the skull with laceration of the dura seems to encourage attempts in the treatment of otitic menin-

gitis in this direction and a number of such attempts have been made, probably many more than have been reported. These attempts, however, were at first without result. Up to 1901 there were only three cases of otitic meningitis on record in which an incision of the dura had exposed and cured a circumscribed focus of pus in the pia. One case was operated on by Macewen, another by Jansen, and the third by Lucae. Friedrich of Kiel is the only one of the otologists who has advocated an active treatment of meningitis. He recommends incision of the dura at the site of infection and then a counter opening in the spinal canal by means of a laminectomy, thus permitting drainage of the entire dural sac. He unfortunately was not able to report any successful cases. It seemed to me worth while to present certain recent observations which show that the incision of the dura apparently exerts a favorable influence on meningitis even if there is suppuration within the meninges.

The first observation was that of a man twenty-four years of age who was admitted to the surgical clinic on account of a fracture of the base. The course after the injury was favorable, so that on the thirteenth day the patient was extremely anxious to return home. On the fourteenth day suddenly a severe otitis media developed on the right side, probably from infection of a hematoma in the tympanum from the tube. The temperature rose to 39° C., 102° F., and the patient became stuporous. Towards evening the right mastoid process was very tender. We proceeded to open the mastoid process, fearing that the retention of pus in the middle-ear cavities would be in direct communication with the interior of the skull on account of the line of fracture. At operation a fracture was found which passed through the mastoid process. The mastoid cells were filled with blood but no pus. There was also an extradural hematoma of the middle cranial fossa. The dura was apparently normal. The result of this operation was absolutely negative. The temperature continued to rise, the patient's stupor increased, and all symptoms of a beginning meningitis were present. The site of infection apparently was a fissure passing through the tegmen of the tympanum and including the dura. Not hav-

ing very much faith in the expectant treatment, we thought it indicated to try draining the exposed infected subdural cavity. Twelve hours after the first operation the dura above and anterior to the ear was exposed by a skin and bone flap. The dura was incised. It appeared normal and pulsated. The exposed pia seemed very œdematous and about a large vein there was a distinct yellowish infiltration which increased towards the base. The culture obtained from this region gave colonies of staphylococci, confirming the diagnosis of purulent meningitis. In order to drain the infected area, a large tampon of iodoform gauze was introduced between the pia and the dura beneath the temporal lobe. The bone flap was then replaced. At first the patient's condition did not seem to be changed. The temperature, however, fell on the next day. The sensorium remained disturbed, then pronounced rigidity of the neck set in. This was followed by a gradual loss of fever and a disappearance of all the meningeal symptoms, so that the patient on the seventh day after operation had a normal temperature and a clear sensorium. A distinct paraphasia was referred not to the meningitis but to a direct traumatism of the exposed part of the brain. The patient then recovered completely during the next seventeen days. The healing of the wound was disturbed locally by the formation of a large cerebral hernia. Then when we had begun to regard the patient as saved, a severe disturbance set in associated with fever, convulsions in the right half of the body, and unconsciousness. As this followed the attempt to replace the cerebral hernia, this was made responsible and the bone flap loosened. These threatening symptoms again disappeared until, six and one half weeks after the injury and one month after the second operation, a fulminating meningitis set in and the patient died within three days. At autopsy a large number of disseminated foci were found whose age cannot be definitely stated, though they appeared normal.

Though in my opinion this case shows that the operation was responsible for this marked improvement, it is not a proof for the curative value of an incision of the dura as the patient finally succumbed to meningitis. I was, therefore,

very much pleased to find in literature a description of two similar cases which recovered.

One patient, reported by Poirier,<sup>1</sup> was a man thirty-two years of age, addicted to alcohol, who had fallen down a flight of stairs and contracted a fracture of the base of the skull. He was taken to the hospital, but left on the third day though he had some fever (38.5°). On the following day, notwithstanding headache, he attempted to go back to work, but had to desist at midday. A picture then rapidly developed very suggestive of meningitis. The temperature rose to 39.8°. Delirium, increased reflexes, but no pain. The patient was immediately readmitted to the hospital, and, as the condition did not improve, on the sixth day after the injury the skull was opened above each auditory canal and an area 6cm. by 5cm. exposed. The exposed tense dura was incised by a crucial incision and a large quantity of bloody, tenacious fluid escaped. On lifting the temporal lobe, two drainage tubes were introduced on each side between the temporal lobe and the bone of the skull. On that evening the temperature dropped to 38.4°. On the fourth day it became normal and the general condition improved so rapidly that the patient was cured after five weeks. The cerebro-spinal fluid contained the staphylococcus albus.

The case reported by Witzel<sup>2</sup> is quite similar. Four days after an injury (fracture of the base) symptoms occurred referable to a meningitis starting from the right ear. On incising the dura and draining, the symptoms promptly disappeared and the patient recovered.

In two other cases in which meningitis followed operations on the mastoid process, Witzel<sup>3</sup> was able to obtain temporary improvement by this procedure. In one case, twelve days later, a generalized fatal meningitis set in. In the other the patient at first did perfectly well, and was presented as cured before a society of physicians. Then, apparently after

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<sup>1</sup> Poirier, *Bulletin et mém. de la société de chir. de Paris*, T. 27, p. 17. Ref., *Zentralbl. f. Chirurgie*, 1901, p. 1181.

<sup>2</sup> Witzel, "Die operative Behandlung der phlegmonösen Meningitis," *Zeitschrift für die Grenzgebiete der Chirurgie und Medizin*, Bd. 8.

<sup>3</sup> *L. c.*



a diagnostic puncture, a brain abscess developed which proved fatal six months after the operation.

A slight improvement was obtained in a case of extensive meningitis by Haberer.<sup>1</sup> The origin in this case was an otitis of the temporal bone, apparently not in connection with the ear.

In another case reported by Witzel<sup>2</sup> there was a complicated fracture, with ulceration of the dura, and a large quantity of pus escaped from the meningeal bag. Recovery occurred after a broad incision, with counter opening and drainage through a suction tampon.

The second case reported by Luc<sup>3</sup> belongs in the group of traumatic meningitides, as the meningitis followed the extirpation of a tumor in the frontal sinus. On the ground of these clinical symptoms Luc incised the dura, and found a circumscribed focus of pus in the pia, puncture for an abscess being negative. In this case recovery also followed, though a brain abscess developed, following puncture.

A very striking and brilliant case is the one reported by Barth, of Danzig, before the Surgical Congress in 1901. This was a case of extensive suppuration throughout the soft spinal meninges, following a penetrating injury. The case recovered after incising the dura and liberating three tablespoonfuls of pus.

Two additional cases can now be added to this list.

The first one was reported by Kuemmel, of Heidelberg. The patient, a girl eleven years of age, suffered from high fever, with rigidity of the neck, for eight days, which could not be explained by her ear disease. At the radical operation—a cholesteatoma being present, we had penetrated the oval window—the dura of the middle and posterior cranial fossa was incised. The pia was clouded and thickened. A diagnostic puncture of the brain was negative. After operation, at first improvement, then two weeks later rigidity of the neck, so that another incision of the dura was made over

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<sup>1</sup> Haberer, *Wiener klin. Wochenschr.*, 1903, No. 13.

<sup>2</sup> *L. c.*

<sup>3</sup> Luc, "Meningite suppurée aigue traumatique," etc., *Archives internationales de laryngologie*, 1897.



the tegmen, when two tablespoonfuls of a clouded fluid escaped. A drainage tube was inserted into this dural opening. Recovery took place slowly, complicated by an attack of erysipelas.

In the second case the clinical symptoms suggested meningitis, though the exact diagnosis could not be made. Vertigo (suppuration of the labyrinth), headache, chills, Kernig's sign with an unclouded sensorium, had existed for eight days. At operation the dura of the middle fossa was incised. The symptoms rapidly disappeared and the patient recovered.

A very remarkable case was that reported by Kuemmel, of Hamburg, because it shows that even severe diffuse meningitis, where the diagnosis was confirmed by the clinical symptoms and by the result of lumbar puncture, was amenable to surgical treatment.

The patient, a man thirty-three years of age, fell on the back of his head from a surface car on December 24, 1904. He remained unconscious for a length of time, then his condition improved for two days. There was a discharge of cerebro-spinal fluid from the nose. Increasing vertigo and headache, especially in the occiput and forehead, set in on the third day. Then tinnitus and deafness on the right side. On December 30th, six days after the injury, he was admitted to the hospital. On admission the patient was able to walk to the ward. He complained of pain in the forehead and occiput. There are no symptoms of paralysis. Eyes intact. Deafness on the right side. There is no injury of the drum. Diagnosis: fracture of the base, passing through the lamina cribrosa and through the ethmoid. The headache increased, the stupor became more pronounced. The temperature rose to 40°, though the pulse was not retarded. On January 2d, completely unconscious, marked rigidity of the neck, and strabismus. Lumbar puncture evacuated 20ccm of a thick, purulent fluid. January 3d, severe symptoms continue. Lumbar puncture has had no result. January 4th, the patient is apparently moribund, pulse is small, there are no focal signs. Without narcosis, on each side of the occipital bone extending to the parietal, a circular trephine opening is made of

about two inches in diameter, which was to be succeeded by an opening of the spinal canal. The dura is excised in these regions. The arachnoid is cloudy and injected. A moderate amount of purulent fluid is liberated. Suction tampons are introduced on each side. The bone flap is replaced. January 5th, conditions very much improved. The pulse is stronger, the sensorium less clouded. Swallowing is not possible. T. 38.8°. On the second day after operation lumbar puncture showed that the cerebro-spinal fluid was still clouded. On the sixth day it was perfectly clear. On the following days the improvement was marked. On the fifth day there was no fever, the patient ceased to cry out, and was able to swallow. Left facial paralysis. On the tenth day the patient's mind is perfectly clear. There is no pain. There is a pronounced disturbance of speech and writing. He is able to understand everything, but always replies with the same words. This condition gradually disappeared in six weeks. In the middle of February, 1905, the patient was discharged completely restored.

Smears from the cerebro-spinal fluid and from the blood were sterile. Kuemmel nevertheless believes that the diagnosis of diffuse meningitis is correct.

In another case reported by Kuemmel, improvement took place after drainage of the dural sac, so that the loss of sensorium which was previously present disappeared. The rigidity of the neck diminished and the headache was improved. Meningitis occurred after an operation for a sacral tumor in a child. The patient died shortly after incising. The autopsy showed that some other very severe conditions were present in addition to the cerebro-spinal meningitis (pelvic peritonitis), so that a complete recovery could not have been expected, even if the meningitis had been cured.

There are, therefore, including the previously mentioned cases of Macewen, Lucae, and Jansen, to-day at least ten cases where meningitis was cured after drainage of the sub-arachnoid space, and five in which a decided improvement took place. In all cases the clinical symptoms before operation were so severe that it could be reasonably suspected that the cases would have died in a short time. In all cases

the improvement followed immediately after operation, so that a connection between these two seems extremely probable. For these reasons it seems that an active treatment of meningitis is not only allowed but, under certain conditions, as in the case of Kuemmel, indicated. The way in which a successful result can be achieved is distinctly shown by these cases. Of greatest importance is the broad exposure of the area where the infection of the meninges took place and where it is reasonable to suppose the principal focus is situated.

In the cases not secondary to the ear or to the nose, traumatic meningitis, this indication can easily be met. The situation is usually defined by the external injury and is usually very accessible. According to Witzel, we should not hesitate to sacrifice as much of the bony skull as is necessary to expose macroscopically the healthy pia. He has himself removed parts of the skull as large as the hand. He does not regard the subsequent plastic operation to cover the defect as particularly grave.

More difficult are the conditions in the cases of meningitis originating from the ear, because from the ear the infectious agents first approach the base of the brain, a part which is not so accessible to operation.

On the other hand, the cases just mentioned show that a successful termination is not excluded as long as the meningitis begins in the middle cranial fossa, namely, at the base of the temporal lobe.

Up to the present time it has not been shown whether meningeal foci at the base of the cerebellum can be exposed by operation. This question, however, is of the greatest interest to the otologist because most otitic meningitides start in this region. The internal auditory meatus, in addition to the sinus wall, is most frequently the site of entrance of infection to the posterior cranial fossa. The former structure is situated at a considerable depth, though we have learned that by removing the posterior surface of the petrous bone and extirpating the posterior parts of the labyrinth this region can be exposed. I have recently had occasion to open and drain a circumscribed intrameningeal abscess in

this area. At the autopsy which occurred a few days later, the patient dying from a cerebellar abscess, we found that this area had been sufficiently exposed and that a further extension of the meningitis had been retarded.

Though theoretically it seems desirable to expose the meningitis just at the site of infection, especially in beginning infections, this is not always essential, as is seen in Kuemmel's case. In this case the infection probably travelled through a fraction of the lamina cribrosa, an area which is probably not accessible. At the time of operation the meningitis had extended over the entire base and the spinal canal, and the location of a dural fistula in this region would probably have not shown any distinct improvement. Kuemmel preferred to drain the deepest parts of the base of the brain—in other words, the region of the occipital lobes.

The second factor essential to the success of the operation is an extensive drainage of the surrounding tissues of the infected area, because we know from our pathological investigations that this area is presumably already infected, although it may appear macroscopically normal. Witzel recommends, in order to produce auto-irrigation of this infected part, that is, from a suction exerted upon the liquor to constantly irrigate the site of infection with fresh liquor, the insertion of large tampons which present radiating prolongations in all directions. These tampons should remain until adhesions between the dura and the pia take place about the primary focus. This in Witzel's experience means two weeks. In removing the tampons care must be exercised not to break up the adhesions. They should be removed under constant irrigation with salt solution.

The cases reported have shown that the danger of the patient is not relieved when the meningitis is apparently brought to a standstill. Very frequently a cerebral hernia takes place. It is acknowledged that it is not always possible to prevent secondary destruction of these prolapsed parts, as after weeks or months a new fatal complication may occur.

A more difficult question is the following: In what cases and when should we operate? I think our present experi-

ence tells us that the chances for recovery are more favorable the shorter is the time between the infection and the exposure of the area. This is not so difficult if we recognize the moment of infection. That is perfectly possible in many traumatic and some otitic meningitides, especially those after fracture of the base. In other otitic meningitis cases the symptoms at the beginning are so ambiguous or so moderate that an exact diagnosis is not possible, especially as lumbar puncture frequently gives us uncertain results.

In these cases we must either wait until the diagnosis is clinically confirmed—in other words, when it will be too late, or we must resolve to do a diagnostic operation, which consists in exposing the pia in the attacked area.

My experience shows that this diagnostic operation does not carry with it great danger for the patient, and it is just as much indicated as a puncture of the brain in suspected abscess or the opening of the sinus in phlebitis.

Though the chances for recovery are greatest in beginning cases, Kuemmel's case of generalized meningitis, which was characterized with the severest clinical symptoms and with the purulent cerebro-spinal fluid, shows that recovery may still take place. We therefore must to-day abandon the dictum previously pronounced that diffuse meningitis is a contra-indication to operation. We are no longer correct in designating these cases as lost. We must always make the attempt to improve the conditions by lumbar puncture if an incision of the dura is not at once undertaken. The results of Gradenigo and others show that this way may be successful. To my mind, drainage after incision of the dura more nearly corresponds to surgical principles as, in addition to the auto-irrigation, it acts constantly, while the puncture of the spinal canal is only temporary. Moreover the site of the lumbar puncture is usually far removed from the infected area. Hence a drainage of the arachnoid space at or near the infection seems more reasonable.

It seems probable that a certain part of the purulent meningitides can be cured by active treatment. The proportion of these cases is, of course, unknown. I myself do not consider that the proportion will be very large on account of the

difficulties caused by the localization, the diagnosis, and the dangers of after-treatment, so that a conjunction of favorable conditions is necessary in order that the termination may be a happy one.



## REPORT OF THE TRANSACTIONS OF THE NEW YORK OTOLOGICAL SOCIETY.

By THOMAS J. HARRIS, M.D., SECRETARY.

MEETING OF MAY 22, 1906. THE PRESIDENT, DR. E. B. DENCH, OCCUPIED THE CHAIR.

### *Presentation of Cases.*

Dr. HERMAN KNAPP presented a patient upon whom he had operated for a **large subperiosteal abscess in the temple** and said: "The skin was a little raised, but otherwise normal. Fluctuation was felt from a little behind the top of the auricle, 10cm. horizontally, and 8cm. vertically through the centre. There was no abnormality on the mastoid, but there had been a purulent otitis for four months. The pus must have taken the somewhat unusual way through the zygomatic cells. I opened the abscess in front of the auricle, liberating a great quantity of pus. Sounding with a probe revealed a smooth surface of the squamous. I stitched the wound loosely.

"Soon after, the upper part of the mastoid was tender, red, and swollen. I opened it: the antrum was large, and full of pus; I cleansed it. The convalescence has been without any unusual feature. I expect that by another week in the hospital he will be well."<sup>1</sup>

*Discussion:* Dr. DUEL stated that he had had a similar case in an infant of three months, where the drum had not been ruptured.

Dr. DUEL presented **photographs** showing the possibility of correcting deformity of the auricle without removing the cartilage.

Dr. WILSON reports **two cases of facial paralysis**, the first

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<sup>1</sup>And so he was.

in a physician, aged sixty, who, after a long drive, developed a partial paralysis of the facial nerve. There was no evidence of involvement of the tympanic cavity. Recovery took place after five weeks under the use of electricity and strychnine. The second case was a woman of thirty, who, on March 29th, contracted a severe coryza, especially of the right nostril. Ten days later pain developed in the ear of the affected side, followed by a total paralysis. When seen by Dr. Wilson a week later, the pain had nearly disappeared. The drum membrane was red. No local treatment. Recovery took place in four weeks under electricity and strychnine. Fugitive facial paralysis without apparent involvement of tympanic cavity is common (Case I.). Subacute inflammation of tympanic cavity accompanied by facial paralysis is rare (Case II.).

*Discussion:* Dr. HASKIN reported a case of a soldier who had suffered from earache followed by total paralysis. The drum membrane was intact. There was a slight stricture of the Eustachian tube. Treatment of the tube. Recovery in four weeks.

Dr. GRUENING had seen a facial paralysis develop in a case of herpes zoster. The drum membrane was intact. Recovery took place upon the disappearance of the herpes.

Dr. GRUENING reported a case of combined **Bezold and extradural abscess**. A youth was brought into the hospital in an unconscious state with a temperature of  $104^{\circ}$ . A history of earache was elicited from the parents. Operation revealed a perforation of the mastoid tip and an abscess upon the dura above the upper knee of the sinus. The temperature fell at once after the operation, and the patient made an uneventful recovery.

*Discussion:* The CHAIRMAN stated that he had seen this combination on several occasions.

Dr. ARNOLD KNAPP inquired as to the duration of the ear disease, and thought that a Bezold abscess usually did not develop early in the course of the otitis.

Dr. GRUENING did not agree with this, and stated that he had frequently seen a Bezold abscess early in the course of acute ear disease.

Dr. GRUENING reported a case of **suspected sinus thrombosis where operation revealed nothing**. He had been asked to see an adult who was running a suspiciously zigzag temperature. The blood examination showed nothing characteristic.

The blood culture was negative. There was no evidence of ear disease, and no enlargement of the spleen or other abdominal organs. A spot of tenderness was present over the mastoid. The temperature rose to  $106^{\circ}$ . Operation showed nothing in the drum membrane, the antrum, or mastoid tip. The sinus was thoroughly exposed, but showed nothing. At the end of the operation a red spot was seen on the forehead, and erysipelas was suspected, but was excluded on the following day. The temperature fell, and the patient recovered.

Dr. BRYANT referred to a case of mastoid operation, followed in nine days by rise of temperature to  $106^{\circ}$  by the mouth, with fluctuations. The sinus was uncovered, and found thickened at the knee. It was opened, but no clot was found. The patient recovered rapidly.

Dr. GRUENING thought that such thickening was not pathological.

Dr. DUEL reported a case of extensive **double mastoiditis** occurring in the fourth week of **typhoid fever**. Both mastoids were necrotic, with perforations at the tips. At the time of operation both sinuses were found exposed and lying in granulations. Temperature of  $100^{\circ}$  at the time of operation. No history of chill. Uneventful recovery.

*Discussion:* The CHAIRMAN stated that in his experience granulations over the sinus usually indicated no clot existing in the sinus.

Dr. BRYANT reported two cases of **sigmoid sinus thrombosis**. The first case, a child of five, resulted favorably. The vein was ligated and opened, but not excised. The jugular bulb was opened along the route of the sinus. Pus was found in the sinus and vein. In the second case, a man of twenty-eight, the vein was not opened. The sinus was opened, and contained pus. There was no bleeding. Death ensued. In both cases, the bone, the meninges, and also the brain tissue adjacent to the knee were black and gangrenous. A dissection of the parts was presented, which showed the method of exposing the jugular bulb along the route of the sinus.

Dr. HASKIN was of the opinion that this method of opening the bulb was dangerous; while he recognized that if the sinus was followed down posteriorly the nerve need not be wounded, the proximity of the cervical vertebra rendered infection in this

locality very liable. He referred to two cases of torticollis following the mastoid operation in the practice of a colleague.

Dr. GRUENING thought the procedure a perfectly safe one in certain cases.

Dr. BRYANT reported his results in the use of the **blood clot in the radical operation**. The external wound was closed, except for the introduction of a small cigarette drain. Out of twenty-three cases done according to this method during the past year, three had become infected, and in these the healing did not seem to have been delayed on that account longer than in the non-infected cases. In all the others, the healing was greatly accelerated. In reply to a question by Dr. Dench, he said that he used no antiseptics in washing the wound, and made no plastic operation upon the canal wall.

Dr. GRUENING's results with the blood clot had been poor.

Dr. HASKIN had had a case recently of acute mastoiditis, where perfect healing after operation followed the primary closure of the wound by means of deep-buried silkworm-gut sutures.

Dr. DUEL raised the question of closing such wounds when the dura or sinus had been exposed, and was strongly opposed to this procedure.

Drs. GRUENING, SHEPPARD, and PHILLIPS agreed with him in this.

Dr. HARRIS reported a **case of facial erysipelas** developing after the mastoid operation, and inquired the experience of the gentlemen present in this respect, as well as to the extension of the erysipelas into the mastoid wound. The patient was a woman of twenty-eight, who had undergone a secondary operation. The entire operation had been performed under strict antiseptic precautions. A short time previously two septic cases had been operated upon in an adjoining operating room. The erysipelas developed on the second day following the operation. It proved quite mild in character, and did not extend into the mastoid wound. On account of the extensive exposure, he was for a time apprehensive of such a possibility.

Dr. PHILLIPS thought there was a possibility of mistaking erythema from iodoform gauze for erysipelas, and was confident that he had seen such mistakes made.

Dr. GRUENING thought that such a mistake should not occur. Erythema from iodoform gauze poisoning did not carry any temperature with it. Erysipelas always does. He reported one fatal

case of otitic erysipelas from his own practice. Here the sinus became thrombosed, and a cerebellar abscess developed. Immediately upon the diagnosis of the complication the case was removed to the isolation ward, and the other patients in the ward, five in number, were sent home. Four out of the five developed erysipelas. He believed, therefore, that erysipelas, where surgical cases were present, should be regarded as contagious.

Dr. TOEPLITZ reported a fatal case of erysipelas following radical operation on the fourth day. Death was due to leptomeningitis and a superficial abscess of the temporo-sphenoidal lobe.

Dr. ARNOLD KNAPP inquired as to the *possibility* of the *intracranial venous sinuses* being under certain conditions *temporarily empty*. He had recently observed, during the dressing of a mastoid wound, the sigmoid sinus apparently empty, without any evidences of thrombosis. The phenomenon of air aspiration followed, with all of the alarming symptoms. The patient recovered.

## REPORT ON THE PROGRESS IN OTOLOGY DURING THE FOURTH QUARTER OF 1905.

BY PROF. ARTHUR HARTMANN, BERLIN.

Translated by Dr. ARNOLD KNAPP.

### ANATOMY AND PHYSIOLOGY.

309. VERNIEUWE. **The development of the cochlea in mammals and in man.** *La presse otolaryngologique Belge*, Nos. 6 and 7.

310. ARULLANI and SEYRE. **On the relation between the nose and blood-pressure.** *Archivio it. di otologia*, etc., vol. xvii., No. 1.

311. GRADENIGO. **On the innervation of the soft palate.** *Archivio it. di otologia*, etc., vol. xvii., No. 1.

312. URBANTSCHITSCH. **On the sensations of the special senses and memory pictures.** *Arch. f. die ges. Physiologie*, vol. 110.

309. VERNIEUWE. *The development of the cochlea in mammals and in man.*

The embryonal development of the vertebrate cochlea proceeds from the base to the apex.

In the formation of the scalæ, the scala tympani is first formed by the union of young intracapsular connective tissue, with progressive atrophy of the cytoplasmic and nuclear elements, accompanied by an active congestion.

Both columns and the external acoustic cells are developed from the small Koelliker's ridge, while the internal auditory cell is developed from the large epithelial ridge.

The two columns are formed from two distinctly different cells, whose nuclei become differentiated in early life. These two elements correspond to the innermost cells of the smallest ridge.

The large ridge consists of numerous layers of cells. On its surface the membrane of Corti first appears. This is a cuticular structure.



The epithelial elements of the habenula sulcata, resembling Reissner's membrane, are transformed epithelia of the primitive cochlear canal. At the summit of the habenula sulcata this epithelium is to be recognized only as a row of nuclei, which are surrounded by a pale cytoplasmic zone and separated from one another by connective tissue. The separating framework is transformed connective tissue, and originates in the young intracapsular connective tissue, which at one time completely surrounds the cochlear canal.

BRANDT.

310. ARULLANI and SEYRE. *On the relation between the nose and blood-pressure.*

From experiments on normal and pathological noses, the authors found that an irritation of the nasal mucosa by energetic massage or galvano-cautery increases the blood-pressure. All pathological conditions of the nose which interfere with expiration can increase the blood-pressure transiently or permanently.

RIMINI.

311. GRADENIGO. *On the innervation of the soft palate.*

The author agrees with the view expressed by Rethi and Lermoyez, that the soft palate is not innervated by the facial nerve but by the vagus.

The following case supports this view. In a patient suffering from chronic purulent otitis, during an operation for sinus thrombosis an extensive collection of pus was found in the jugular bulb. Complete paralysis of the right vocal cord and of the right half of the soft palate occurred, with slight involvement of the hypoglossus, as shown by a deviation of the tongue to the left side. The sterno-cleido-mastoid and trapezius muscles were paralyzed. No facial paralysis. Gradenigo believes that the suppuration in the bulb caused a compression of the nerves as they passed through the jugular foramen.

RIMINI.

312. URBANTSCHITSCH. *On the sensations of the special senses and memory pictures.*

This author brings observations on after-perceptions, on the localization of the various sensations with especial regard to the sense of temperature, and on acoustic and optic memory pictures.

The acoustic after-perceptions are sometimes qualitatively different from the inciting tone, in some cases higher. The difference in tone may be limited to certain groups and be of the

same extent for various tones. These tone differences can easily be recognized if, during the after-perception, the objective tone can be also perceived. By aid of two tuning-fork tones, of which one corresponds to the subjective and the other to the objective tone, the difference can be exactly estimated.

In the case of two tones differing by a number of vibrations, the vibrations can be distinctly recognized by the ear, but a simultaneous action of both subjective and objective tones causes no difference in vibrations.

The weak overtones of the fundamental tone usually are not perceived in the after-sensation, so that the tone produced by the harmonica and by the tuning-fork may produce the same after-sensation. Acoustic memory pictures occur sometimes in hallucinatory distinctness.

Striking examples of auditory memory pictures of different persons are the following: the correctness of wrongly perceived auditory impressions, the gradual formation of a sentence with retarded comprehension of a sentence which was not understood, and the subsequent comprehension of a sentence of which at first not a single word was correctly understood. BRUEHL.

#### GENERAL.

##### *a.*—GENERAL PATHOLOGY.

313. ZILLIACUS. Disturbances of hearing in railway employees. *Finska läkaresällsk. handl.*, 1905, No. 50.

314. BRUEHL. Examinations of the hearing and anatomical conditions found present in progressive deafness. *Berliner klin. Wochenschr.*, 1905, No. 50.

313. ZILLIACUS. *Disturbances of hearing in railway employees.*

In 1885-6, 124 employees were examined and 286 in 1902, of whom 94 were examined for the first time. Of 227 guards and brakemen, 35.2 % had normal hearing, 42.2 % showed a distinct diminution, and 22.2 % presented a moderate loss of hearing. If these are graded according to the years of service, it is seen that after five years of service not one-half possess normal hearing, after 25-36 years not one-quarter, while marked disturbances of hearing are very much increased. Of the engine-drivers 29.5 % had normal hearing, 40.9 % a decided and 29.5 % a moderate diminution of hearing. The number of normal hearing after 5 years' service is 45.1 %, while after 15 years not one possessed normal hearing, and the marked disturbances of hearing had

increased very much. After 35 years there was but one who had only a moderate degree of disturbance in hearing.

In comparison 249 prisoners were examined, and it was found that if these were arranged in groups and compared to the railroad employees the diminution in hearing in both classes remains the same. In some the railroad employees even seem to hear better. The author, therefore, believes that service on the railroad has no particularly injurious effect on the hearing. He concludes that normal hearing is not necessary, inasmuch as the auditory signals used can be easily heard, even by persons with reduced hearing.

MOELLER.

314. BRUEHL. *Examination of the hearing and anatomical conditions found present in progressive deafness.*

This is a short description of the various forms of progressive deafness, and their diagnosis by aid of tuning-forks and their pathological anatomy.

MUELLER.

b.—METHODS OF EXAMINATION AND TREATMENT

315. QUIX. *The forms of vibrations of a forked and bent rod, of tuning-forks, and of the handle of the tuning-fork.* *Physiol. Labor. der Utrechter Hoogeschool*, vi., 1905.

316. BACHAUER. *Progress in the treatment of ear diseases.* *Deutsche med. Wochenschr.*, No. 49, 1905.

317. BERGH. *On massage of the mucous membrane in certain ear diseases.* *Norsk mag. f. læg.*, 1905, p. 1259.

318. BRAUN. *On some new local anæsthetics (stovain, alypin, and novocain).* *Deutsche med. Wochenschr.*, 1905.

319. SPEISS. *The advantage of negative pressure in the treatment of dry atrophic catarrh of the nose and throat.* *Arch. f. Laryngol.*, vol. xvii., 2, 1905.

320. PRYM. *On the treatment of inflammatory diseases of the tonsils with the suction apparatus.* *Münchener med. Wochenschr.*, No. 48, 1905.

321. HONNETH. *On the value of Sonderrmann's suction apparatus in the diagnosis and treatment of diseases of the nose.* *Münchener med. Wochenschr.*, No. 48, 1905.

322. KIRSCHNER. *Paraffin injections in the human tissues.* *Virchow's Arch.*, vol. i., 82.

323. UHTHOFF. *On injuries of the eye after paraffin injections in deformities of the nose.* *Berliner klin. Wochenschr.*, No. 47, 1905.

315. QUIX. *The forms of vibrations of a forked and bent rod, of tuning-forks, and of the handle of the tuning-fork.*

From experimental and theoretic observations on the forms of

vibrations of a tuning-fork the author comes to the following conclusions :

1. The handle of a tuning-fork complicates the tuning-fork by the addition of new forms of vibrations which vary with the method by which the fork is held and the pitch.
2. Following this complication the tuning-fork cannot be regarded as a source of sound which will always produce the same effect. In the case of a tuning-fork it is very difficult to perceive a tone with an exactly similar clang-tint and intensity in the physical sense.
3. The previously observed transverse vibrations of the handle of the fork are all rod tones as has just been described.
4. Forced transverse vibrations of the handle of the fork are very rarely of the same pitch as the true tones of the tuning-fork.
5. The longitudinal movement of the handle in the ordinary tuning-forks may be regarded as a mass movement.

BRUEHL.

316. BACHAUER. *Progress in the treatment of ear diseases.*

This paper describes certain methods of treatment which are practised in the Munich University Ear Polyclinic (Prof. Haug). The treatment in furunculosis of the canal has become more conservative and incisions are avoided if possible. Gauze saturated with acetate of aluminium is introduced into the canal. When there is considerable pain a gauze soaked in a 3-10 % alcohol solution of anæsthesin is used.

To anæsthetize the canal for small operations the methods of Laval and von Eiken are recommended. These consist in injecting the solution of cocain subcutaneously near the ear canal. Laval makes two injections, one in front of the tragus and the other behind the auricle, while von Eiken makes one injection behind the auricle directly underneath the cartilage of the floor of the canal. The latter author has been able to anæsthetize the middle ear by bringing cocain into the attic through the previously anæsthetized Shrapnell's membrane. This method has been satisfactory in the extraction of the hammer and anvil.

The suction treatment of Sonderrmann was also tried in order to see how thoroughly the discharge could be removed in purulent otitis, and the author seems to have been well satisfied with this method.

A decided advance is the method recommended by Politzer

and others of filling the operative wound after the mastoid operation with paraffin.

Finally the method of Bier is spoken of where by congestive hyperæmia in acute inflammations of the ear in many cases operations have been avoided.

317. BERGH. *On massage of the mucous membrane in certain ear diseases.*

The excellent effect of massage was shown in a case of ethmoiditis with secondary ear disease where the mucous membrane was massaged with a probe, the remnants of polypi disappeared, the air passages were restored, and the tinnitus relieved. Massage of the nose and naso-pharynx was attempted without good result in various diseases of the ear.

MOELLER.

318. BRAUN. *On some new local anæsthetics* (stovain, alypin, and novocain).

Stovain is not applicable to the nose and larynx because it makes the mucous membrane too hyperæmic and is too irritating. Alypin is as suited for tissue injections as stovain. The application of a 10% solution is just as anæsthetic to the mucous membrane as a corresponding solution of cocain except that the alypin is less poisonous. Novocain is an anæsthetic of almost ideal freedom from irritation. Even a 10% solution injected under the skin produces no reaction. When combined with suprarenin it is a very powerful anæsthetic. Its solutions, moreover, are permanent and can be sterilized by boiling. For the nose and larynx a 10% solution is recommended, with the addition of three drops of a  $\frac{1}{1000}$  suprarenin solution.

NOLTENIUS.

319. SPIESS. *The advantage of negative pressure in the treatment of dry atrophic catarrh of the nose and throat.*

The author believes that negative air-pressure causes an increased congestion of the mucous membrane and thereby incites activity of the glands and prevents atrophy of the mucous elements. When persistently applied he believes it has produced permanent results in atrophic processes. It is of diagnostic importance in nasal suppurations and in the treatment of acute infections. The somewhat complicated apparatus consists of an electric air-pump with various appliances for the nose and throat.

ZARNIKO.

320. PRYM. *On the treatment of inflammatory diseases of the tonsils with the suction apparatus.*



The suction therapy brought amelioration of the symptoms without any harm. Hypertrophy of the tonsils was not influenced.

SCHEIBE.

321. HONNETH. *On the value of Sondermann's suction apparatus in the diagnosis and treatment of diseases of the nose.*

In Eschweiler's polyclinic the suction apparatus is warmly recommended in the diagnosis of nasal accessory empyemata. As to its therapeutic advantage the author is sceptical, and was not able to obtain any improvement in chronic suppurations. From an experiment on the cadaver he thinks it is possible to aspirate the antrum of Highmore completely. The reviewer does not think this can be physically possible, because in man the increase of the suppuration is influenced by the negative pressure.

SCHEIBE.

322. KIRSCHNER. *Paraffin injections in the human tissues.*

It has been generally accepted that injected paraffin heals at the place of injection and remains in a permanent condition. The author has examined a number of cases. The first case was one in which soft paraffin had been injected into the nose of a man. Two and a half years after the injection a gradual progressive inflammation set in which increased and extended to the forehead. In two operations it was possible to remove the greater part of this cartilaginous swelling. Microscopic examination of the excised piece of tissue showed that **the injected soft paraffin had been completely absorbed, and from an irritation in the surrounding tissues had led to a severe destruction of tissue—namely, chronic inflammation with necrosis.**

The interesting histological details must be read in the original paper.

Hard paraffin of a high-melting point is also absorbed, which process is very much facilitated by the peculiar lack of density of the paraffin. Five specimens from various parts of the body, which had remained one and one-half years in place and then had to be removed on account of local disturbance, showed distinctly the various stages of this process of absorption. The conclusions are as follows:

The paraffin injected for the correction of deformities, whether soft or hard, is not successful, because the connective tissue organization does not cease at any given moment, but continues indefinitely, and finally results in the complete absorption of the



paraffin. Moreover, both forms of paraffin cannot be injected in certain parts of the body, because they are not well borne and cause severe local disturbance requiring early removal.

If these observations of Kirschner's are confirmed, the use of paraffin will have to be abandoned. Owing to the importance of the question it seems desirable that all observations should be published. A case of my own which resembles the first one in this paper could not be reported because the specimen was unfortunately lost.<sup>1</sup>

HOELSCHER.

323. UHTHOFF. *On injuries of the eye after paraffin injections in deformities of the nose.*

The first case, a woman, forty-five years of age, on the third injection of paraffin (boiling-point  $43^{\circ}$ , injection at  $46-47^{\circ}$ ) became suddenly blind in the left eye from embolism of the central retinal artery. Uthtoff believes that the embolism was caused by a particle of the paraffin which passed through the pulmonary circulation in fluid condition.

The second case, a man, fifty-seven years of age. Two months after the injection of paraffin, suddenly a painful swelling of the eyelids appeared, which led to a permanent thickening of the lids and complete closure of both palpebral fissures. Four months later the opening of the lids was made possible by removing large pieces of a hard tumor-like tissue from the eyelids, leaving a decided deformity. Microscopic examination showed that in the tumor-like masses the tissue was infiltrated with paraffin, and there was intervening inflammatory proliferation (giant cells).<sup>1</sup>

MUELLER.

#### C.—DEAFMUTISM.

324. LINDT. *On the pathology of congenital deafmutism. Deutsches Arch. f. klin. Med., vol. lxxxvi.*

This is a histological description of the temporal bones of a deaf-mute who was not examined during life, and the principal changes found in the labyrinths.

The external and middle ears were normal.

The labyrinth capsule was normal, with the exception of a

<sup>1</sup> The Editor was asked a few months ago to remove the paraffin which had been infiltrated into the subcutaneous layer of the lower lid of a young man, to facilitate the extirpation of the lachrymal sac into which it had been injected. I found the sac as usual, but the lower eyelid was thickened, somewhat nodular, and hard. I refused; having no experience with paraffin. The doctor might perhaps get it out if he heated the eyelid so that the paraffin, made liquid, could sicker out through some incisions made into the skin.—H. K.

small otosclerotic focus in the bone on the right side. The entire bony labyrinth was of normal proportion.

The spiral ganglion was atrophic.

There was atrophy of the cochlear nerve in the trunk, and especially marked in the fibres in the cochlea.

The saccular branch was atrophic. There was normal development of the ramus utriculo-ampullaris and ampullaris posterior. Marked degeneration of the epithelium, especially of the neuro-epithelium of the inferior part of the membranous labyrinth, of the cochlea, and of the saccule. Normal development of the superior part of the membranous labyrinth, of the utricle, and of the semicircular canal with their nerve terminals.

The fibres of the cochlear nerve presented an abnormal picture owing to post-mortal and artificial changes. BRUEHL.

#### EXTERNAL EAR.

325. RAOULT. *Tuberculosis of the lobule of the ear in the form of eczema.* *La presse otolaryngologique Belge*, No. 9, 1905.

326. FORSELLES. *Acquired atresia of the external auditory canal.* *Helsingfors*, 1905, p. 45.

325. RAOULT. *Tuberculosis of the lobule of the ear in the form of eczema.*

This case of tuberculosis seemed at first to be an eczema of the auricle, which began two years ago, after the bite of a fly. The patient was a boy thirteen years of age. The tumor was decreased in size from ignipuncture, then after a year the auricle had enlarged enormously, the skin became infiltrated and covered with many red ulcerating nodules. The diagnosis lay between tuberculosis and actinomycosis until the histological examination showed the tuberculous nature. Characteristic were the slow development (five years), the many tuberculous nodules, the softness of the tissue resembling a lipoma or angioma, the serous discharge, and the formation of scales. BRANDT.

326. FORSELLES. *Acquired atresia of the external auditory canal.*

Fifty-two cases were collected from literature, to which are added three of traumatic origin. In one of these a plastic operation was successfully performed. MOELLER.

#### MIDDLE EAR.

##### a.—ACUTE OTITIS MEDIA.

327. KEPPLER. *On the treatment of inflammatory conditions of the*

head and face with congestive hyperæmia. *Münchener med. Wochenschr.*, No. 45, 1905.

328. SOKOLOW. A case of hemorrhage from the internal carotid artery in acute purulent otitis media. *Medizinskoje Obosrenje*, No. 16, 1905.

329. SPRAGUE. Scarlatinous otitis. *Arch. internat. d'otol.*, etc., No. 6, 1905.

330. DAAE. Primary diphtheria of the ear. *Norsk mag. f. læg.*, p. 987, 1905.

327. KEPPLER. *On the treatment of inflammatory conditions of the head and face with congestive hyperæmia.*

The part on the ear in this paper is almost a verbal copy of the article published in this periodical. The results of Heine (see report of the last meeting of the German Otological Society), where nineteen cases had to be operated upon, are regarded by the author as not at all bad.

A new case from Bier's clinic is extensively reported. In a child, one and one-half years of age, suffering from otorrhœa for one week, there was a large perforation in the drumhead with exfoliation of the necrotic hammer and a gravitation-abscess. The abscess was incised, and congestion was applied. After one and one-half months, healing took place, with arrest of the discharge, and later with closure of the drumhead. A favorable case of subperiosteal abscess behind the auricle is also reported.

Bier has applied congestion for years in meningitis, however, in pronounced cases without any result. In a recent case healing took place, in which, on the third day after the radical operation, there were vomiting, headache, loud cries, apathy, fever (39.4°). inequality of pulse, rigidity of neck, and cutaneous hyperæsthesia, Lumbar puncture was not performed.

SCHEIBE.

328. SOKOLOW. *A case of hemorrhage from the internal carotid artery in acute purulent otitis media.*

The carious process produced extensive destruction of the petrous bone and eroded the carotid artery. As a result there were repeated hemorrhages, with fatal issue on the eleventh day.

SACHER.

329. SPRAGUE. *Scarlatinous otitis.*

The ears of 60 scarlet-fever patients were examined, and in 10 cases there was a purulent otitis. In 7 it was bilateral, in 3 on only one side. In 2 of the cases mastoiditis developed. In 5 the hearing returned to normal; in 2, not-

withstanding proper treatment, chronic otitis developed; in the other 3 cases the results were not to be determined. Clinically, the author regards the varieties of otitis occurring in scarlet fever as falling into three classes: acute serous, acute purulent, and acute gangrenous otitis. Regarding paracentesis, he occupies an extreme standpoint, stating that we should not wait until the ear discharges; this waiting is a disastrous neglect. As soon as the drumhead shows the slightest sign of an inflammation, or there is exudate in the tympanum, a paracentesis must be immediately undertaken.

OPPIKOFER.

330. DAAE. *Primary diphtheria of the ear.*

A boy eleven years of age had suffered from pain in his right ear for several days. The drum was red, the mastoid area tender. On paracentesis a moderate amount of serous, sanguinolent fluid, with a few grayish-white threads, was liberated. After a few days the depth of the canal was filled with whitish membranes. Culture revealed diphtheria bacilli. The mucosa in the nose and throat showed only cocci. After ten days deposits appeared on the tonsils. As the rise in temperature and tenderness continued, the mastoid operation was undertaken. The cells contained pus and pseudo-membranes. A few days later there were a failure of vision of the right eye and a pulmonary embolus, so that, presumably, a sinus thrombosis had occurred. Ultimate recovery.

MOELLER.

b.—CHRONIC PURULENT OTITIS.

331. SLATOWEROW. *Caries of the hammer and anvil and their operative removal.* *Russki Wratsch*, 1905, No. 20.

332. GUISEZ. *Recovery of a case of mental confusion by the radical cure of a double purulent otitis.* *La presse otolaryngologique Belge*, 1905, p. 10.

333. VEDOVA. *Modern views on suppurations of the labyrinth.* *La pratica oto-rino-laringoiatrica*, 1905, No. 6.

331. SLATOWEROW. *Caries of the hammer and anvil and their operative removal.*

The results of operation on 28 cases are published. Of these 19 recovered, 7 are unfinished, in 4 the purulent discharge changed to a mucoid, and in one finally the radical operation had to be undertaken. Of those that recovered, in 15 a distinct improvement of hearing took place, while in the others the hearing

remained the same. Based on these observations, the author believes that the removal of the carious ossicles, notwithstanding its great technical difficulties, should receive due consideration.

SACHER.

332. GUISEZ. *Recovery of a case of mental confusion by the radical cure of a double purulent otitis.*

During the examination of a young girl in whom a condition of stupor alternated with periods of excitement, and who refused nourishment, suffering from hallucinations of sight, smell, and taste, and from ideas of persecution, a double-sided purulent otitis after scarlet fever was found present. Suitable treatment and an operation on the right side relieved the physical condition. The case is reported because the author believes that the aural lesion suffices in those with hereditary and neuropathic tendencies to awake the slumbering disposition to mental disease.

BRANDT.

333. VEDOVA. *Modern views on the suppuration of the labyrinth.*

This is a review of the important articles which have recently appeared on the diagnosis and operative treatment of labyrinth suppurations. The literary references are complete. RIMINI.

C.—CEREBRAL COMPLICATIONS.

334. MENDES. *An extradural abscess of otitic origin.* *Archivio italiano di otologia*, etc., vol. xvii., No. 2.

335. DELSAUX. *Otitic meningitis treated by an extensive resection of the skull; death, autopsy, report.* *La presse otolaryngologique Belge*, 1905, No. 12.

336. UCHERMANN. *Otitic pyæmia and infectious sinus thrombosis.* *Norsk mag. s. læg.*, 1905, p. 913.

337. GUNNAR. *A remarkable case of otitic pyæmia.* *Hygeia*, 1905, p. 1182.

338. STENGER. *On otitic pyæmia.* *Medizinische Klinik*, 1905, No. 28.

334. MENDES. *An extradural abscess of otitic origin.*

This is a complete description of a case of extradural perisinuous abscess, with conditions found at operation, and remarks.

RIMINI.

335. DELSAUX. *Otitic meningitis treated by an extensive resection of the skull; death, autopsy, report.*

This case is remarkable on account of the extended period of the meningeal process, which only on the last days invaded the



base of the brain. Local signs of a meningitis were entirely absent, and examination of the eye-grounds was negative. Lumbar puncture proved to be valuable not only from the diagnostic but also from a therapeutic point of view. BRANDT.

336. UCHERMANN. *Otitic pyæmia and infectious sinus thrombosis.*

The author distinguishes between otitic pyæmia (where there is no thrombosis) and otitic infectious sinus thrombosis. The first form coincides with Koerner's osteophlebitis pyæmia. In 6085 autopsies performed in the main hospital in Christiania, from 1865 to 1902, there were 21 cases of sinus phlebitis. Of these, 18 were of otitic origin. From 1891 to the conclusion of 1904, 30 cases of otitic pyæmia and infectious sinus thrombosis were treated in the Ear Clinic; in 20 cases males, in 10 females. Ten were right-sided, 18 left-sided, and 2 bilateral. In 18 of the 25 the inflammation in the mastoid process extended directly to the sinus wall, and in 6 there was a perisinuous abscess; in 7 there was, microscopically, no connection. In the 5 cases of simple pyæmia there was no direct connection between the focus in the mastoid process and the sinus wall.

Of the 5 cases of otitic pyæmia, 3 were uncomplicated and followed an acute suppuration. They all got well. One case of chronic suppuration and one after a labyrinth-suppuration were examined at autopsy, but no sinus thrombosis was found present. Among the infectious sinus thromboses, 5 occurring after an acute suppuration recovered, whereas of the remaining 20, 10 died. One case was complicated by meningitis, one by cerebral abscess. One case was interesting on account of the presence of a large occipital abscess. A few days after operation a large amount of foetid pus was discharged from the nose and mouth, presumably coming from the sphenoidal sinus. The autopsy, however, showed that the suboccipital abscess had perforated into the pharynx.

The symptoms and the course of treatment are then taken up. In order to prevent pyæmia the author makes it a rule, when, in an acute suppuration, notwithstanding a large perforation of the drum, fever persists for eight days, to open the mastoid process. If the slightest sign of a cerebral complication is present, the sinus wall must be exposed, even if the intervening bone seems healthy. The metastatic abscess must be opened and irrigated.



As to the physical signs of a thrombus, pulsation of the sinus is without value. A sinus is only present with certainty when there is a firm band, or when there is a fistula in the sinus wall, or when the sinus wall is depressed so that there is a free space between the wall and the bone. It is best not to make a diagnostic puncture. If there is no disintegration in the sinus the sinus wall need not be evacuated, and the result of the primary operation observed. In the presence of emboli, or when the jugular vein is inflamed, the ligation takes place preferably above the facial vein.

MOELLER.

337. GUNNAR. *A remarkable case of otitic pyæmia.*

The patient suffered from right-sided acute otitis with serous exudate and choked disk. Three days later the middle cranial fossa was exposed. There was no pus in the mastoid process. At the region of the knee the sinus was hard. In the sinus there was a thrombus with disintegration corresponding to the discolored area. Continuous temperature and a poor general condition led to a ligation of the jugular vein two days later. Various metastatic suppurations occurred, of which one, an arthritis of the humerus, necessitated resection of the joint. Recovery.

MOELLER.

338. STENGER. *On otitic pyæmia.*

An acute suppuration of the ear (staphylococci), running a mild course after the onset of a new attack of angina (streptococci), presented a mastoiditis with severe inflammatory and general symptoms, and joint metastases rapidly developed. At the mastoid operation (streptococci pus) the sinus was found healthy. The joint metastases and the septic symptoms seemed to be produced by a bulb thrombosis, so that the jugular was ligated and the bulb exposed, which proved to be healthy. On opening the knee-joint it showed pus with streptococci. Slow recovery of the other joint affections during treatment with Cr  d  's ointment.

The disease of the mastoid process in this case was not the origin of the general infection but only an intermediate member. The case shows that not necessarily every py  mia occurring in the course of an acute otitis is the result of an ear disease. Under the circumstances it would have been better to have selected a different title, because the case which has been reported is not one of otitic py  mia.

HOELSCHER.

## d.—OTHER MIDDLE-EAR DISEASES.

339. GOERKE. *Exudations and plastic processes in the middle ear.* *A. f. O.*, vol. lxx., p. 226.

340. Urbantschitsch. *The treatment of chronic middle-ear catarrh.* *Deutsche med. Wochenschr.*, Nos. xlvii., and xlviii., 1905.

339. GOERKE. *Exudations and plastic processes in the middle ear.*

These investigations on the inflammations of the middle ear with intact drum are based on about 2000 autopsies. In the autopsies of adults exudates were very frequently found in the middle ear which had given no signs during life and which proved histologically to be inflammatory exudates exactly like those found in nurslings. After a description of the normal anatomy of the mucous membrane, including a discussion of the presence of glands in the tympanic mucosa and a description of the embryonal mucous tissue and a description of the processes in its disappearance, the pathological conditions in the mucous membrane are described. The infiltration is most marked underneath the mucous membrane, less in the antrum and mastoid cells than in the tympanum. Circumscribed foci of infiltration were found chiefly in the promontory wall and in the drum. Exudates were found principally in the tympanum and in the mastoid cells, rarely and to a slight degree only in the tube. The sites of predilection were the windows, the posterior pocket of the drum membrane, the tympanic floor, the space between the ossicles, the ligaments and the drum and especially Prussak's space. The changes which the exudate undergoes as it becomes organized are extremely interesting. Granulation tissue appears in those parts of the mucous membrane where the epithelium is absent, and vessels develop from the granulation tissue into the exudate, thus forming the cavity proliferations of Preysing, which, according to the author, have nothing to do with the disappearance of the embryonal tissue, but are also found in the organization of the exudate in adults. Absorption of the bone was observed in only very few cases, and then only in the mastoid cells. The formation of new bone is a frequent condition also, chiefly in the mastoid processes.

This form of acute exudative otitis is found in most forms of death from acute or chronic disease. The individual is always weakly and decrepid, in whom the lack of resistance on the part

of the tissue favors the onset of the otitis. This otitis is therefore described as the otitis of the hectic, and the author thinks it incorrect to differentiate the otitis media of the sucklings as a particular condition. Under this title there are many otitides which have been regarded as specific forms of otitis in the various infectious diseases. The extremely striking frequency of this condition in children is explained by the relatively poor physical conditions of the children in the hospitals.

From a pathologic standpoint, acute otitis, according to the author, should be characterized as otitis media exudativa, plastica, and necroticans.

HAENEL.

340. This lecture, designed for the practising physician, treats of such methods as: the air douche, the introduction of fluids and vapors into the middle ear, the introduction of the bougie into the tubal canal, massage, electricity, and certain operations; and finally the various diseases of the nose and naso-pharynx and the general condition of the body.

The author recommends the introduction of the bougie into the tube because this method gives admirable results, especially in the hypertrophic forms. The various forms of massage are less favorably spoken of. He has also used with advantage electricity, especially the galvanic current. Operations like the division of adhesions, tenotomy of the tensor tympani and of the stapedius muscle, extraction of the ossicles, and mobilization of the stapes are not described as they do not apply to the general physician. The methodical hearing-exercises are scarcely mentioned. The article concludes with a description of the affections of the nose and throat and the treatment of the general health which are of such great importance in these conditions.

NOLTENIUS.